

DEPARTMENT OF THE ARMY
TECHNICAL MANUAL

DEPARTMENT OF THE AIR
FORCE TECHNICAL ORDER

TM 11-2312A
TO 10F1-3-11

CAMERA

PH-545A/PF



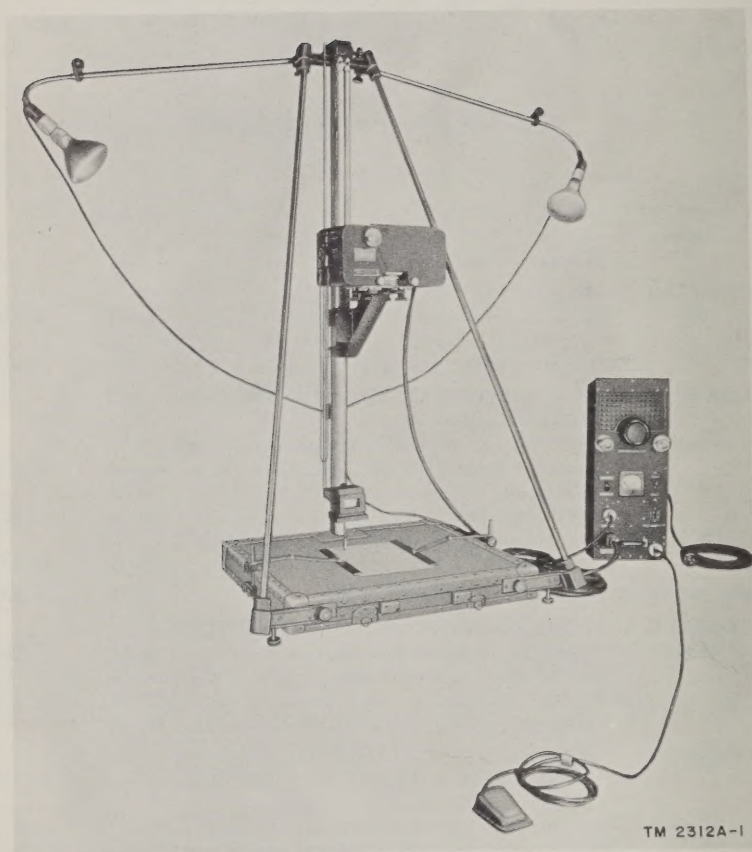
DEPARTMENTS OF THE ARMY AND THE AIR FORCE
JANUARY 1955

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DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D. C., 6 January 1955

CAMERA PH-545A/PF

	Paragraph	Page
CHAPTER 1. INTRODUCTION		
Section I. General	1, 2	1
II. Description and data	3-11	3-15
CHAPTER 2. OPERATING INSTRUCTIONS		
Section I. Service upon receipt of equipment	12-17	18-26
II. Operation under usual conditions	18-22	27-44
III. Operation under unusual conditions	23-26	46, 47
CHAPTER 3. ORGANIZATIONAL MAINTENANCE INSTRUCTIONS		
Section I. Organizational tools and equipment and preventive maintenance services	27-31	48-52
II. Lubrication	32-35	54-56
III. Weatherproofing	36, 37	56, 57
IV. Trouble shooting at organizational maintenance level	38-42	57-60
CHAPTER 4. THEORY OF OPERATION	43-48	65-70
CHAPTER 5. FIELD MAINTENANCE INSTRUCTIONS		
Section I. Inspecting, stripping, and cleaning	49-51	71, 72
II. Trouble shooting at field maintenance level	52-54	72, 73
III. Repairs	55-60	77-101
IV. Alinement procedures and final testing	61, 62	101-104
CHAPTER 6. SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE		
Section I. Shipment and limited storage	63, 64	105
II. Demolition of material to prevent enemy use	65, 66	105
INDEX		107



TM 2312A-1

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

These instructions are published for the information and guidance of all concerned. They contain information on the operation, organizational and field maintenance, and theory of the equipment, as well as a description of the components. They apply only to Camera PH-545A/PF.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army equipment and in performing preventive maintenance:

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745-45-5 (Army); Navy Shipping Guide, Article 1850-4; and AFR 71-4 (Air Force).

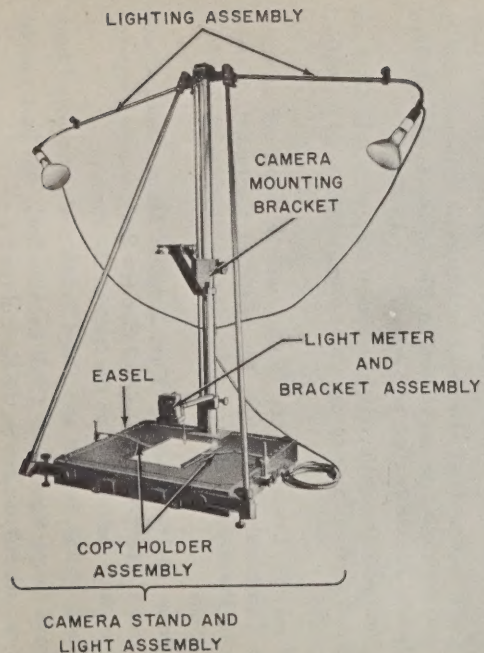
b. DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700-45-5.

c. DD Form 535, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700-45-5 and AFR 65-26.

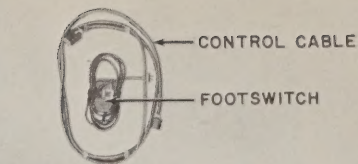
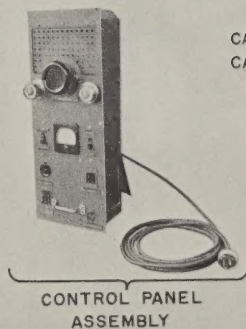
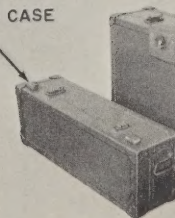
d. DA Form 11-254, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Still Camera Set), will be prepared in accordance with instructions on the back of the form.

e. DA Form 11-255, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Still Camera Set), will be prepared in accordance with instructions on the back of the form.

f. Use other forms and records as authorized.



CAMERA

CONTROL CABLE
AND
FOOTSWITCH
ASSEMBLYCONVERSION
KITCONTROL PANEL
ASSEMBLYCAMERA STAND
CARRYING CASECAMERA CARRYING
CASE

CARRYING CASES

Section II. DESCRIPTION AND DATA

3. General Description

Camera PH-545A/PF is portable, record-copying equipment that operates semiautomatically to photograph bound or unbound documents on either 35-mm (millimeter) or 16-mm nonperforated microfilm.

a. The equipment operates on 115 ± 5 volts alternating current (ac) or, when used in conjunction with a converter, on 115 ± 5 volts direct current (dc). The camera is capable of photographing documents up to 20 by 27 inches when operated in the vertical position (fig. 1) and up to 37 by 42 inches when operated in the horizontal position (fig. 19) to photograph wall-mounted documents.

b. All the components that are packed in the two carrying cases (fig. 2) can be set up for operation within 10 to 15 minutes. The camera stand carrying case and the camera carrying case are transported easily. The principal units contained in the two cases are: a still picture camera, light meter, copyholder assembly, conversion kit, lighting assembly, control panel assembly, camera stand, 16-mm and 35-mm film spools, control cable, and foot switch.

c. Forward comments on this publication directly to: Commanding Officer, The Signal Corps Publications Agency, Fort Monmouth, New Jersey, ATTN: Standards Branch.

4. Table of Components

(figs. 2, 11 and 12)

Quantity	Components	Dimensions (in.)			Weight (lb)
		Length	Width	Thickness	
1	Camera carrying case and easel base.	28	24	9-1/2	90
1	Camera consisting of body, lens, and tape measure.	12-1/2	6	5-5/8	21
1	Conversion kit, consisting of:				
	2 upper adapters				
	1 spindle adapter, 16-mm				
	1 guide assembly, 16-mm				
	1 platen assembly, 16-mm				
1	Exposure meter and rod assembly	12	2-1/2	1	
2	Lamp arm assembly				
1	Cable assembly	144			
4	Flood lamp (2 in use, 2 spares)				
1	Foot switch	3	5	1	1/2
2	35-mm, 100-ft, take-up film spool (1 in use, 1 spare)				
2	16-mm, 100-ft, take-up film spool (1 in use, 1 spare)				

1	Control panel assembly	22	8-1/2	4	19
	1 film spool gage, 16-mm				
	1 film spool gage, 35-mm				
1	Camera stand carrying case	34	12	9	50
1	Camera stand, consisting of:	60	36	26	
	1 post assembly (2-piece)				
	2 brace assemblies (2-piece)				
	1 clamp assembly (light meter)				
	1 bracket assembly (camera mounting)				
	1 bar assembly (2-piece, calibrated)				
	1 bracket assembly (post assembly, top)				
	2 lamp arm assemblies (2-piece unit)				
	2 copyholder assemblies (1 ea side)				
	2 copyholder posts (1 ea side)				
	2 arm assemblies (right and left)				

5. Description of Camera

The camera is basically a 35-mm, still picture camera with an adjustable aperture and a reduction scale adjustment; a 16-mm conversion kit is supplied to adapt the camera for 16-mm film. The principal divisions of the camera are as follows:

a. *Camera Body* (figs. 3 and 4). The camera body is a rectangular-shaped casting. A solid metal partition divides the camera into a front (or film) compartment and a rear (or mechanism) compartment (figs. 28 and 29). For orientation purposes, the film compartment side of the camera is referred to as the front, and the opposite side as the back. References to right or left sides mean right or left of the camera. The side of the camera that accommodates the lens assembly is referred to as the bottom, and the opposite side of the camera, as the top. The front of the camera contains the two-section door that incloses the film compartment. The right side contains an aperture control knob, an exposure counter, and a footage indicator. The left side contains a power receptacle. Four threaded lugs are located on the back of the camera for mounting the camera for horizontal operation, and four other lugs are located on the bottom of the camera for mounting it for vertical operation. A plate located on the back of the camera covers the mechanism compartment of the camera and contains the exposure counter reset knob.

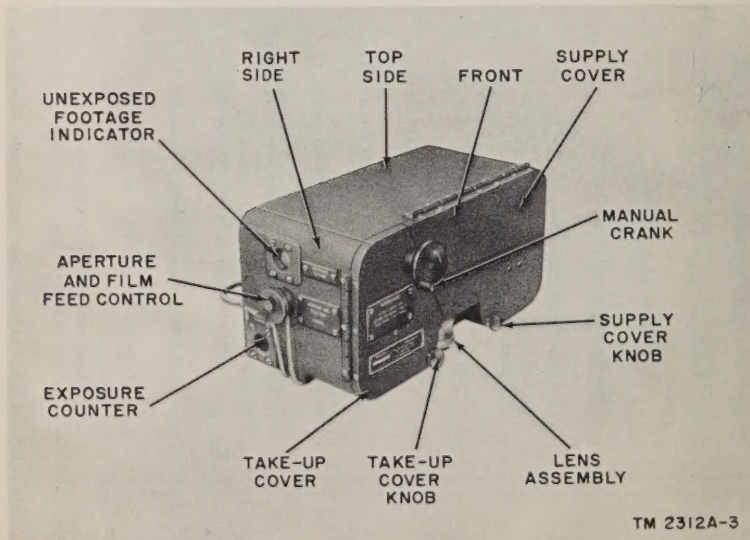
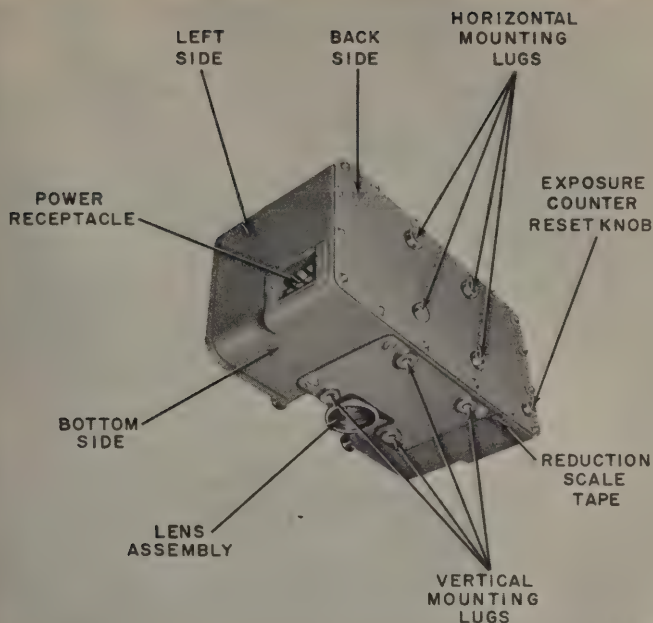


Figure 3. Camera front, top, and right side.



TM 2312A-4

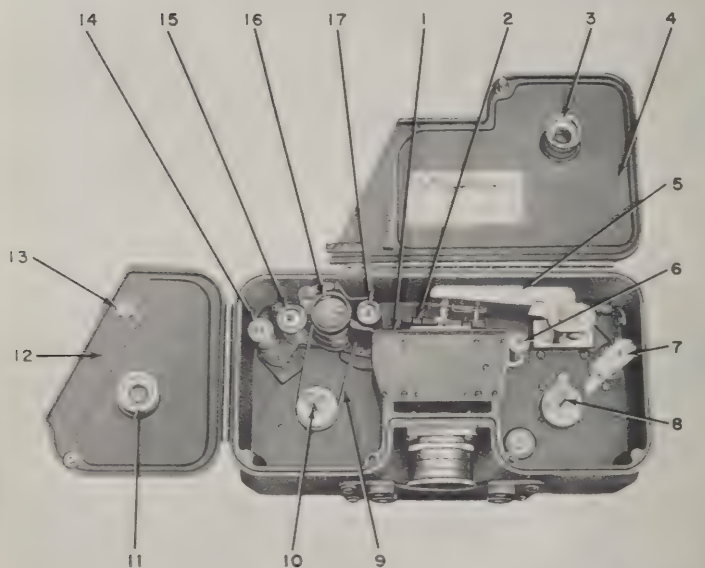
Figure 4. Camera back, bottom, and left side.

b. Film Compartment and Inclosure Doors (fig. 5). The film compartment, further divided into a lighttight supply chamber and a lighttight take-up chamber, is covered by a two-section compartment door. It is possible either to open the take-up chamber door and keep the supply chamber closed and lighttight, or to open both doors and expose the entire film compartment. The winding crank that is mounted on the take-up cover is designed to advance the film manually when space must be allowed at the end of one microfilming job and prior to starting the next job. The crank also is used to take up the leader at the beginning of a fresh reel of film and to take up the trailer at the end of a completed spool. When the take-up cover is closed, the serrations on the wheel on the inside of the cover mesh with the dowels on the end of the rubber-covered film transport roller to provide a manually operated drive to the transport roller. Each section of the film compartment door is secured by a threaded shaft and knurled knob assembly to make the film compartment lighttight.

- (1) *Film spools.* Two 35-mm and two 16-mm, 100-foot take-up film reels are packed in the camera carrying case. One of

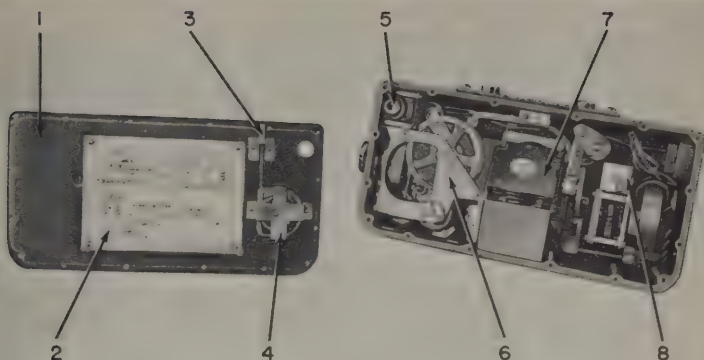
each of the 16-mm and the 35-mm reels is for use in the camera, and one of each is a spare. No supply reels are provided with this equipment.

- (2) *Supply chamber* (fig. 5). The supply chamber contains the supply spindle on which is mounted the supply spool and the platen arm assembly. The platen arm, designed to use either the 16-mm or 35-mm platen, is used to lower the platen. This holds the film tightly against the film guide plate so that the film will be in the focal plane of the path of light coming through the lens. The film unrolls from the supply spool in a counterclockwise direction. It is threaded around the various rollers as shown in figure 18. An arm assembly rides on the film as it unwinds from the supply spool. This



- | | | |
|----------------------|----------------------|--------------------------------|
| 1. Film guide plate. | 7. Arm assembly. | 12. Take-up cover. |
| 2. Platen assembly. | 8. Supply spindle. | 13. Wheel. |
| 3. Plug. | 9. Drive spring. | 14. Roller assembly (take-up). |
| 4. Supply cover. | 10. Take-up spindle. | 15. Roller assembly (take-up). |
| 5. Platen arm. | 11. Plug. | 16. Film transport roller. |
| 6. Roller assembly. | | 17. Roller assembly. |

Figure 5. Film compartment.



TM 2312A-6

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|---|---------------------------------------|
| 1. Camera back cover. | 5. Exposure counter reset knob. |
| 2. Schematic, camera. | 6. Film transport group. |
| 3. Felt wiper and bracket. | 7. Projection and photographic group. |
| 4. Reduction factor tape measure and bracket. | 8. Power group. |

Figure 6. Camera mechanism compartment.

arm operates the **UNEXPOSED FOOTAGE** meter (fig. 3) which indicates the amount of film remaining on the supply spool. It also is incorporated as an alarm; when the supply of film is exhausted, the film breaks, or if the film is not feeding properly off the supply spool, the arm assembly trips a microswitch which then causes the alarm buzzer to sound.

- (3) *Take-up chamber.* The take-up chamber houses the take-up spool and spindle, the film take-up rollers, and an alarm assembly. The film is threaded around the various rollers as shown in figure 18. The alarm roller, which supports the loop of film before it is wound on the take-up spool, is under spring tension. If the film breaks, the alarm roller will react to the spring tension to close the circuit and sound the alarm buzzer.

c. *Mechanism Compartment and Cover Assembly* (fig. 6). The mechanism compartment is located at the back of the camera and is made accessible when the back cover is removed from the camera. A flexible steel reduction scale coiled in a housing is fastened to the inside of the back cover. The tape is calibrated in reduction factors to cor-

respond with similar markings on the camera lens assembly. A schematic diagram is also fastened to the inside of the back cover. The exposure counter is located in the mechanism compartment, and the exposure counter reset knob projects through the back cover. The contents of the mechanism compartment are roughly grouped as a power unit, a projection unit, and a film transport unit. The power unit consists of various components, such as the single revolution actuator motor, microswitch and alarm buzzer, transformer, and relays. The projection unit contains such items as the projection lamp, front and rear condenser lenses, 45° mirror, and shutter and mirror assembly. The lens assembly, although not located in the mechanism compartment, is usually considered a part of the projection unit. The film transport unit contains the essential components for advancing the film. These include the feed roll drive assembly, switch actuator assembly, feed cam assembly, counter assembly, and the various gears and linkages which operate as a part of the advance mechanism. The theory of operation of the components of the mechanism compartment is found in paragraphs 44 through 48.

d. *Lens Assembly* (fig. 7). The lens assembly is a 75-mm, f/4.5 Ektar enlarging lens positioned in an adjustable lens mount. An index line is marked on the lens mount. On one side of the index line is an adjustable aperture scale calibrated f/4.5, 5.6, 8, 11, 16, 22, and 32. On the other side of the index line is an adjustable reduction scale calibrated 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18. The aperture scale adjustment corresponds with the light meter reading, and the reduction scale

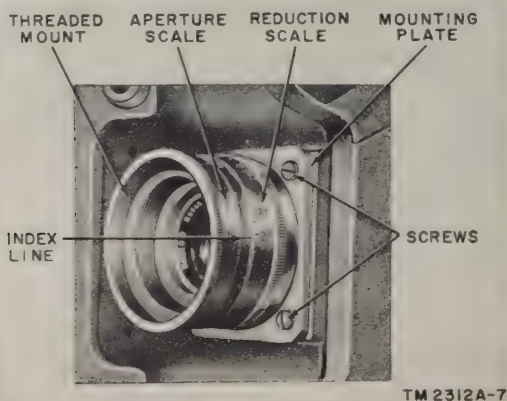


Figure 7. Lens assembly.

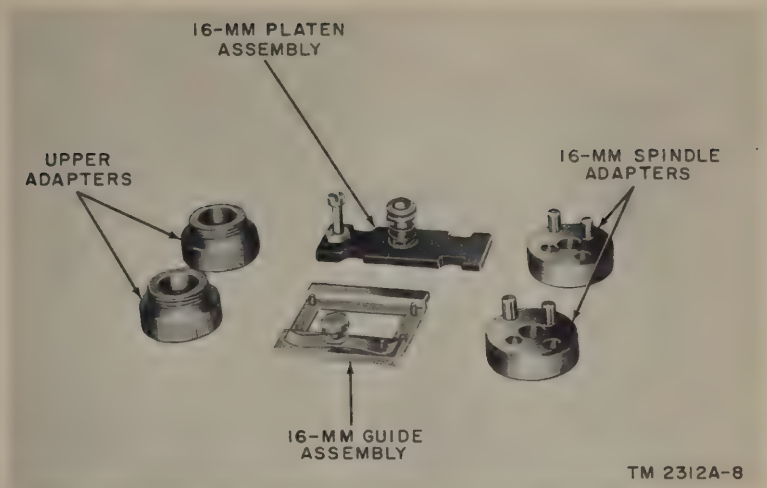


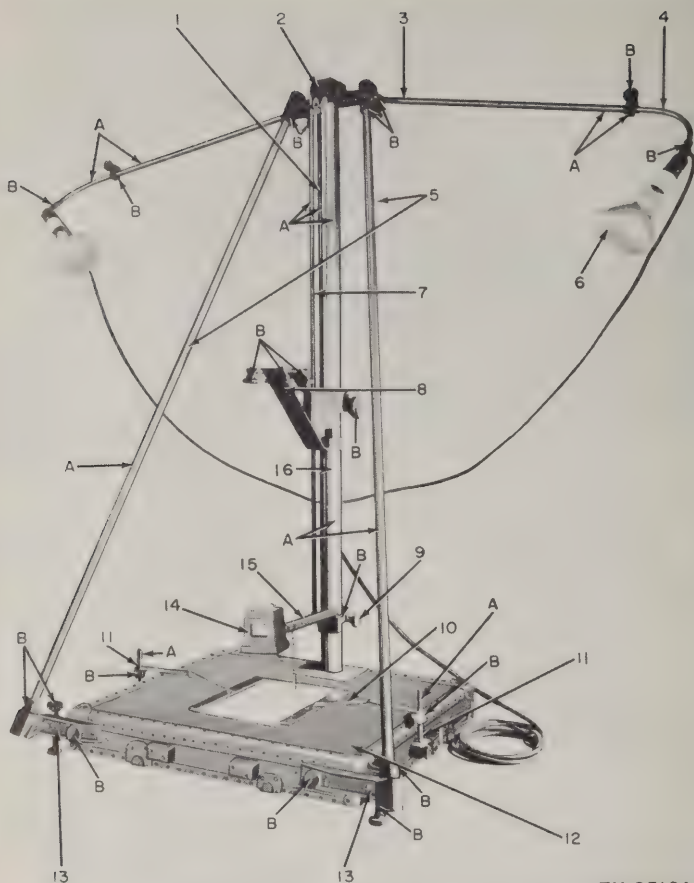
Figure 8. Conversion kit.

is adjusted to correspond with the reading on the calibrated rod on the camera stand (fig. 9). The distance from the mounting flange to the focal plane is 2.906 inches. The front end of the lens mount is threaded to accept the filter ring. Also included is a lens cap.

e. *Conversion Kit* (fig. 8). Camera PH-545A/PF is a 35-mm camera using 35-mm film. A conversion kit is furnished to adapt the camera for 16-mm film. For 35-mm film operation, a 35-mm platen is installed on the platen arm. For 16-mm film operation, a 16-mm platen is installed on the platen arm in place of the 35-mm platen, and a 16-mm guide assembly is mounted in the camera to center the film for proper exposure. To compensate for the difference in thickness of the 16-mm and the 35-mm film spools, two sets of adapters are used. One set of adapters, threaded on one end, is screwed into the plugs on the inside of each film compartment door. The other set of adapters, two dowels on one side of each, is mounted one over each spindle of the camera with the dowels projecting outward to mate with the slots in the 16-mm film spools to turn them.

6. Description of Camera Stand and Accessories (fig. 9)

The top cover of the camera carrying case, which is detachable, is used as the base or easel of the camera stand. The camera stand components are packed in the camera stand carrying case. The two-piece post assembly is threaded together and then screwed into the



TM 2312A-9

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|-----------------------------------|----------------------------------|
| 1. Counterweight assembly. | 9. Clamp assembly. |
| 2. Top mounting bracket assembly. | 10. Copy holder assemblies. |
| 3. Lamp arm. | 11. Copy holder post assemblies. |
| 4. Lamp assembly. | 12. Easel. |
| 5. Brace assembly. | 13. Arm assemblies. |
| 6. Flood lamp. | 14. Light meter. |
| 7. Calibrated bar assembly. | 15. Rod assembly. |
| 8. Camera mounting bracket. | 16. Post assembly. |

A and B. Lubrication points (par. 34 b).

Figure 9. Camera stand and accessories.

easel. A clamp assembly fits over the post assembly to hold the rod assembly which, in turn, supports the light meter. The meter is calibrated in arbitrary units from 0 to 15. The clamp assembly is adjustable and is positioned, for copying operations, so that the plumb-bob attached to the rod assembly just makes contact with the copy. The camera mounting bracket, mounted on the post assembly, is adjustable. A counterweight assembly, installed in the camera mounting bracket, is designed with two steel tapes which attach it to the two studs on the top mounting bracket assembly. In manipulating the camera up and down, the counterweight assembly functions to provide easy movement of the camera. Two lamp assemblies, with flood lamps installed, are attached to two lamp arm assemblies which are attached to the top mounting bracket assembly. Clamps on the lamp assembly permit the lamp assembly to rotate inside the lamp arm assembly; the lamp assemblies also are pivoted to provide additional movement of the lamp assemblies. A calibrated bar assembly is slid through a hole in the top mounting bracket assembly past an index pointer on the left side of the camera mounting bracket and is then seated in a recessed hole in the clamp assembly. When the clamp assembly is moved up or down to position the plumb-bob correctly in relation to the copy, the bar assembly, calibrated from 8 through 18, is free to move with it. The appropriate reduction factor is indicated opposite the index finger on the camera mounting bracket. An arm assembly is attached to both front corners of the easel to secure the brace assemblies. It also provides leveling adjustment to compensate for uneven floors. Two hinged copyholder assemblies, adjustable up and down on two copyholder post assemblies, are provided to hold copy of varying sizes and thicknesses securely on the easel. The major components of the camera stand are of stainless steel construction.

7. Description of Control Panel Assembly

(figs. 2 and 16)

The control panel assembly (4, fig. 12) is packed in the camera carrying case, but is removed from the case and located near the camera stand during preparation for use. To give it upright support, a hinged bracket on the back of the panel is used. The control panel contains various switches, receptacles, meters, and controls for operating the camera, lighting equipment, and the panel controls. The control panel is designed to operate from a 110- to 120-volt, 60-cycle ac power source; but a provision has been made so that 110- to 120-volt dc power source may be utilized provided at least a 150-watt, vibrator or rotary-type converter is available. An **ILLUMINATION CONTROL** is included to provide variable illumination of the flood lamps connected to the panel. A 16-mm and a 35-mm film spool gage are located, one on either side of the control panel. They are inserted between the

flanges of the film spools to establish the proper clearance for the film. A detailed description of the controls is furnished in paragraph 18. A control cable assembly and a foot switch assembly (fig. 2) are attached to the underside of the cover. The control cable electrically connects the control panel and the camera; the foot switch assembly, which is connected to the FOOT SWITCH receptacle on the control panel, is the control for initiating the copying action.

8. Carrying Cases
(figs. 2, 11, and 12)

All equipment for Camera PH-545A/PF is contained in two carrying cases. The camera carrying case contains the cable assembly, still picture camera, control panel assembly, flood lamps, lamp assembly, film reels, light meter, foot switch, and conversion kit. The camera stand carrying case contains the various parts of the camera stand. The interior of each case is divided into compartments and provided with straps or knobs to hold the equipment securely for transporting.

9. Spare Parts

Spare parts are supplied as follows: two 300-watt, 90-volt, reflector flood lamps; one 35-mm, 100-foot, take-up reel; and one 16-mm, 100-foot, take-up reel. These spare parts are packed in the camera carrying case.

10. Technical Characteristics

Camera.....	35-mm still picture.
Lens.....	75-mm, f/4.5 Ektar enlarging lens.
Film reels.....	35-mm or 16-mm, 100-foot capacity film reels.
Lighting equipment.....	Two 300-watt, 90-volt, reflector flood lamps, which operate from either a 115 \pm 5 volts, 60 cycles ac or a 115 \pm 5 volts dc power source.
Exposure.....	Actuated by foot switch, which lowers platen, exposes film, raises platen, then advances film to prevent double exposures.
ILLUMINATION CONTROL..	Rheostat control knob on control panel provides variable light intensity for copying.

- Shutter and mirror assembly.....Optical system designed so camera is used not only for photographing documents, but also for projecting a rectangle of light to indicate the exact field of view of the camera at any distance from the easel. Shutter speed is .5 seconds.
- Conversion kit.....Camera may use either 16-mm or 35-mm film.
- Projection light.....27-watt lamp, 32 candle power.
- Power source.....115 \pm 5 volts, 60-cycles ac or 115 \pm 5 volts dc with converter.

11. Packaging Data

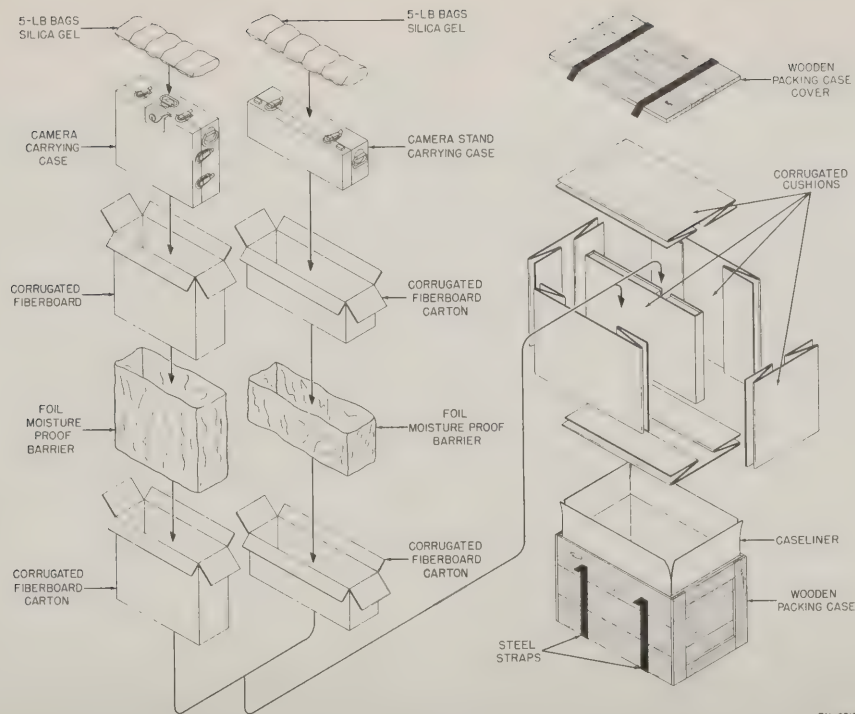
a. Domestic Shipment (fig. 10). The camera carrying case and the camera stand carrying case are first packed in a sealed, corrugated-paper carton provided with a desiccant and suitable moistureproof barriers. Then the packaged equipment is placed in a second corrugated-paper carton and sealed.

b. Oversea Shipment (fig. 10). The camera carrying case and the camera stand carrying case as packed for domestic shipment are placed within a wood-cleated plywood box or a nailed, wooden box. The box is lined with a waterproof-paper caseliner. Corrugated-paper cushions are used to separate the two cartons containing the equipment and to protect the top, bottom and sides of the cartons. The box is bound with steel straps.

c. Size and Weight. The case, which measures approximately 3-1/2 by 2-1/2 by 3 feet, has a cubic volume of 26-1/4 feet and a gross weight of approximately 290 pounds.

d. Packing Data. The following table lists the equipment included in the camera carrying case and the camera stand carrying case. The camera carrying case, packed, weighs 90 pounds; the camera stand carrying case weighs 50 pounds.

Nomenclature and/or identification	Number of items per case
Camera carrying case contains:	
Cable assembly	1
Foot switch	1
Camera	1



TM 2312A-10

Figure 10. Packaging diagram.

d. Packing Data (contd)

Nomenclature and/or identification	Number of items per case
Control panel assembly	1
(16-mm film spool gage)	1
(35-mm film spool gage)	1
Photoflood lamp	4
Lamp assembly	1
16-mm film reel	2
35-mm film reel	2
Light meter assembly (rod assembly and plumb-bob included)	1
Conversion kit consisting of:	
16-mm spindle adapters	2
16-mm guide assembly	1
Upper adapters	2
16-mm platen assembly	1
Easel assembly	1
Camera stand carrying case contains:	
Lamp arm assembly (1 ea side)	2
Brace assembly (top and bottom pieces)	2
Post assembly (top and bottom pieces)	1
Bar assembly (top and bottom pieces)	1
Arm assembly (lh)	1
Arm assembly (rh)	1
Copy holder assembly (1 ea side)	2
Clamp assembly	1
Bracket assembly	1
Bracket assembly	1

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

12. Uncrating, Unpacking, and Checking New Equipment (fig. 10)

Equipment may be received packed for either domestic or oversea shipment. To unpack and check equipment packed for oversea shipment, proceed as instructed below.

Note. The procedures for removing the equipment from domestic packing begin with subparagraph *d* below.

a. Cut the steel straps on the case with metal snips. To avoid injury, handle the sharp ends of the straps carefully while removing them.

b. Remove any of the nails from the lid of the packing case with a nail puller. Do not attempt to pry off the lid; contents may become damaged.

c. After the lid has been removed, cut open the caseliner and remove the corrugated cushions. Lift out the two cartons.

d. Cut open each carton at the taped edges. Remove the moisture-proof barrier and all barrier materials.

e. Cut open the second carton and remove the cases.

f. Examine the cases for evidence of damage. Damage due to shipping is improbable if the cases are intact.

g. Set up the equipment (pars. 14 through 16) and actuate all moving parts (par. 20 through 22). Attached parts should fit readily without binding. Clamps, screws, and fastenings should tighten securely. Controls and adjustments should move freely without binding. If the equipment has been used previously, refer to paragraph 17 for checking instructions.

13. Locating

The equipment is designed for interior use and should be operated under conditions where dust and exposure to extensive heat, cold, or moisture are minimized. Use a shelter in which it is possible to control the light and minimize the dust and moisture wherever possible. Locate the equipment near at least one 110- to 120-volt, 60-cycle ac outlet. Proceed as follows:

- a. Set up the equipment away from avenues of heavy traffic so that the copying operation may be carried on with a minimum of interruption and confusion.
- b. Avoid any source of flickering light, such as an electric welder, that may fall on the lens or documents to be photographed.
- c. Do not attempt to take photographs near a source of radioactive emission. When sensitized film is shielded from visible light, it still may be fogged when in the vicinity of radioactive material.
- d. Choose a location away from doors; the wind or draft may sweep grit into working parts of the camera.

14. Assembly of Camera Stand

(figs. 9 and 11)

The components of the camera stand are packed in the carrying case. The top cover of the camera carrying case (fig. 12) is detached to become the base or easel of the camera stand. The components are secured in the carrying case with clamping devices and straps. Make sure that all such straps and devices are removed or released before attempting to remove the components from the case. Proceed as outlined below to assemble the camera stand.

- a. Remove the cover from the camera carrying case and place it on the floor to become the base and easel. Remove the rubber plug from the top surface of the easel. Remove the foot switch and cable assembly from the inside of the cover.
- b. Remove the two-piece post assembly from the case and screw the two sections securely together. Insert the threaded end of the joined post into the fitting in the top of the easel. Turn the post until it is fully seated in the fitting and mounted securely.
- c. Slip the clamp assembly over the post assembly and position it near the bottom of the post by tightening the knob. Insert one end of the rod assembly into the light meter, and the other end into the clamp assembly. The clamp assembly is adjustable. For copying operations, position it so that the plumb-bob which is attached to the rod assembly just makes contact with the copy.

d. Slip the camera mounting bracket over the post assembly and position it midway on the post by tightening the knob; then place the top mounting bracket assembly on top of the post assembly. Attach the two steel tapes, which are part of the counterweight assembly installed in the camera mounting bracket, to the two studs on the top mounting bracket assembly. When the camera is manipulated up and down, the counterweight assembly will function to provide easy movement of the camera. When the camera is not mounted, be careful when loosening the knob to move the camera mounting bracket up or down; the effect of the counterweight assembly will have to be overcome to lower the camera mounting bracket, and will have to be resisted when raising the bracket.

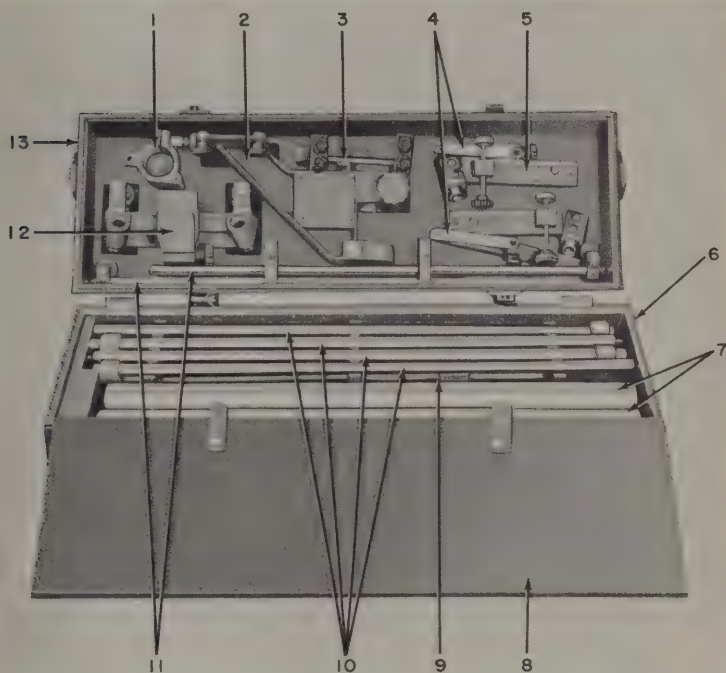
e. Remove the arm assemblies from the camera stand carrying case and fasten the right-hand arm assembly to the right front corner and the left-hand arm assembly to the left front corner of the easel.

f. Remove (from the case) the four pieces which comprise the two, two-piece brace assemblies. Join the male and female halves of each assembly securely together. The two brace assemblies are interchangeable. Insert one end of one of the brace assemblies into the opening provided in the arm assembly and the other end into one of the openings in the bracket assembly. Install one end of the other brace assembly in the other arm assembly and the other end into the other opening in the bracket assembly. Make sure that all four of the ends of the brace assemblies are inserted in their respective fittings so that the collars on the tubes come in contact with the threaded portion of the fittings; then tighten the four nuts to secure each joint. Tighten the knob on the bracket assembly to secure the bracket to the post assembly, after making sure that it is seated properly.

g. Remove the two-piece bar assembly from the camera stand carrying case and join the threaded ends securely together. Slip one end of the assembled bar assembly through the hole provided in the right side of the bracket assembly, and slide the bar assembly down and insert the bottom end into the mounting hole in the clamp assembly. It may be necessary to loosen the knob on the clamp assembly so that proper alignment of the bar assembly can be effected. After completing the installation, tighten the knob on the clamp assembly. Make sure that the reduction factor numbers on the bar assembly are not inverted and that the consecutive numbers read from 8 at the bottom to 18 at the top of the bar. Loosen the knob on the clamp assembly and move the clamp up and down the post assembly several times to make sure that the bar assembly does not bind as it slides through the hole in the top mounting bracket; then, retighten the knob.

h. Remove the two, two-piece holder assemblies from the camera stand carrying case and install a post assembly, one on each side of the easel assembly. Tighten the knob on each assembly to hold it securely. Slip the copyholders over the ends of the posts just installed. After positioning them correctly on the easel, tighten the knobs on each copyholder assembly to hold it securely. The copyholders are adjustable up and down to compensate for the varying thicknesses of the documents to be photographed.

i. Remove the two single-piece lamp arm assemblies from the camera stand carrying case. Insert one end of each into the fittings pro-

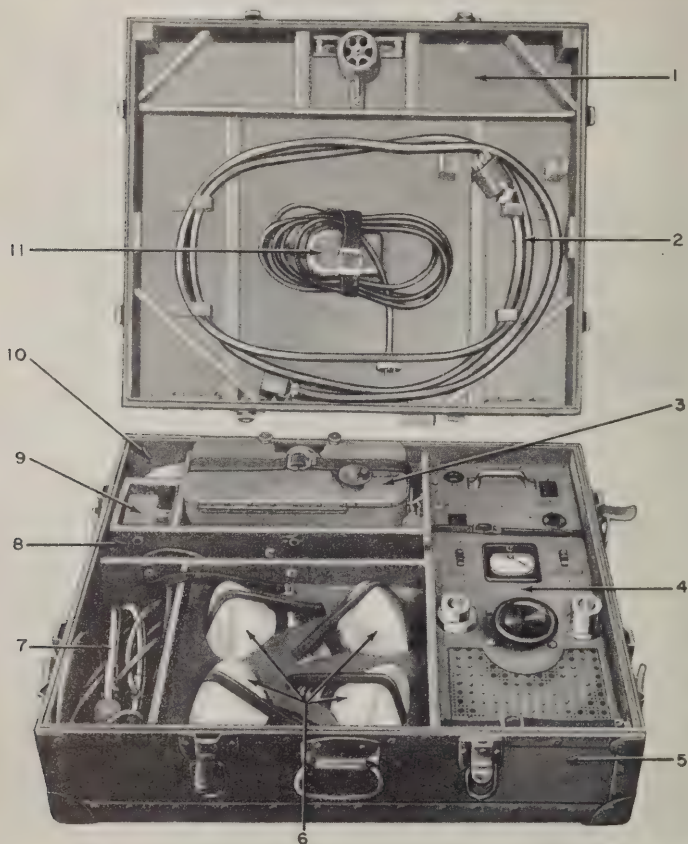


TM 2312A-11

- | | |
|------------------------------|------------------------|
| 1. Clamp assembly. | 7. Post assembly. |
| 2. Bracket assembly. | 8. Cover. |
| 3. Copy holder post. | 9. Bar assembly. |
| 4. Copy holder assembly. | 10. Brace assembly. |
| 5. Arm assembly (lh and rh). | 11. Lamp arm assembly. |
| 6. Camera stand case cover. | 12. Bracket assembly. |
| 13. Camera stand case base. | |

Figure 11. Camera stand carrying case, showing components.

vided on the bracket assembly. It may be necessary to loosen the knobs on the top mounting bracket assembly in order to slip the end of the lamp arm through the fitting and into the supports at the center. Tighten the knobs to secure the arms. Remove the dual lamp assembly from the camera carrying case and install a lamp assembly into the end of each



TM 2312A-12

- | | |
|----------------------------|-----------------------------------|
| 1. Easel. | 6. Flood lamps. |
| 2. Cable assembly. | 7. Lamp assemblies. |
| 3. Still picture camera. | 8. Film supply slot. |
| 4. Control panel assembly. | 9. Light meter. |
| 5. Camera carrying case. | 10. Conversion and adapter parts. |
| 11. Foot switch. | |

Figure 12. Camera carrying case, showing components.

of the lamp arms. Loosen the knobs on the lamp arms to insert the lamp assembly; then, tighten the knobs to secure them. The lamp assembly may be rotated in the lamp arm as needed; this assembly is secured by tightening the knobs on the lamp arm. A joint in each lamp assembly further facilitates positioning of the lighting equipment. Remove the two photoflood lamps from the camera carrying case and install one in each of the lamp assemblies. The plug on the end of the cable to the lamp assembly is connected into the LAMP receptacle on the control panel during preparation for use.

15. Installation of Camera

(figs. 13 and 14)

Remove the camera from the camera carrying case. Raise the camera mounting bracket on the camera stand to a convenient level for mounting the camera.

a. *Vertical Installation.* Place the camera on the camera mounting bracket so that the vertical mounting lugs and the screws in the cam-

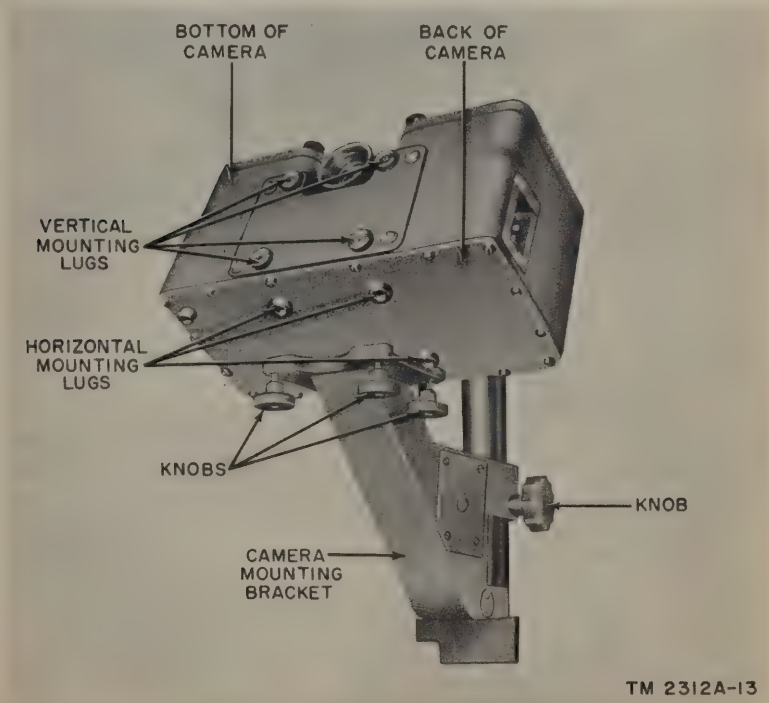


Figure 13. Horizontal positioning of camera.

era mounting bracket are in alinement. Then tighten the knobs uniformly to secure the camera.

b. Horizontal Installation. Place the camera on the camera mounting bracket so that the horizontal mounting lugs and the screws in the camera mounting bracket are in alinement. Then tighten the knobs uniformly to secure the camera in the horizontal position.

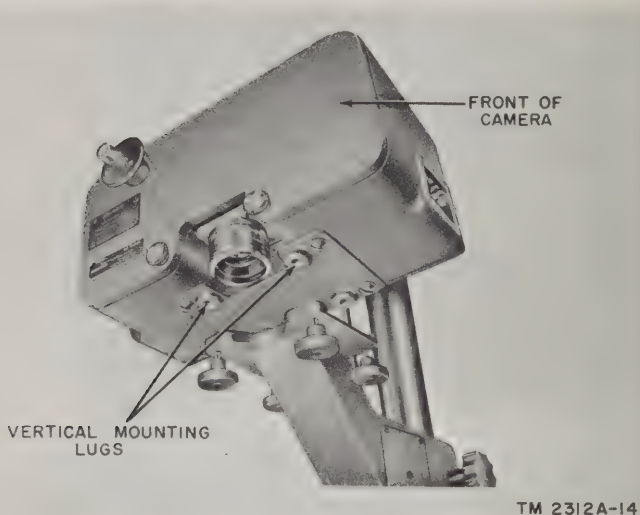


Figure 14. Vertical positioning of camera.

16. Control Panel Installation and Electrical Connections (fig. 15)

Remove the control panel assembly from the camera carrying case and place it convenient to the camera stand as shown in figure 15. Before making any electrical connections, be sure that the control panel main power ON-OFF switch is in the OFF position. Some of the connections listed below may have been completed during assembly or installation of the equipment. In any case, check all connections for proper installation, security of mounting, and positive connections.

a. Connect the lamp assembly power plug into the receptacle on the control panel labeled **LAMPS**.

b. Place the foot switch convenient to the camera stand and control panel as shown in figure 15. Connect the foot switch power plug into the receptacle on the control panel labeled **FOOT SWITCH**.

c. Connect the six-pronged end of the cable assembly into the mating receptacle on the control panel labeled **CAMERA SUPPLY**. Connect the other end of the cable into the receptacle on the left side of the camera.

d. Connect the control panel power plug into either a 100- to 120-volt, 60-cycle power source or a 110- to 120-volt dc power source. If

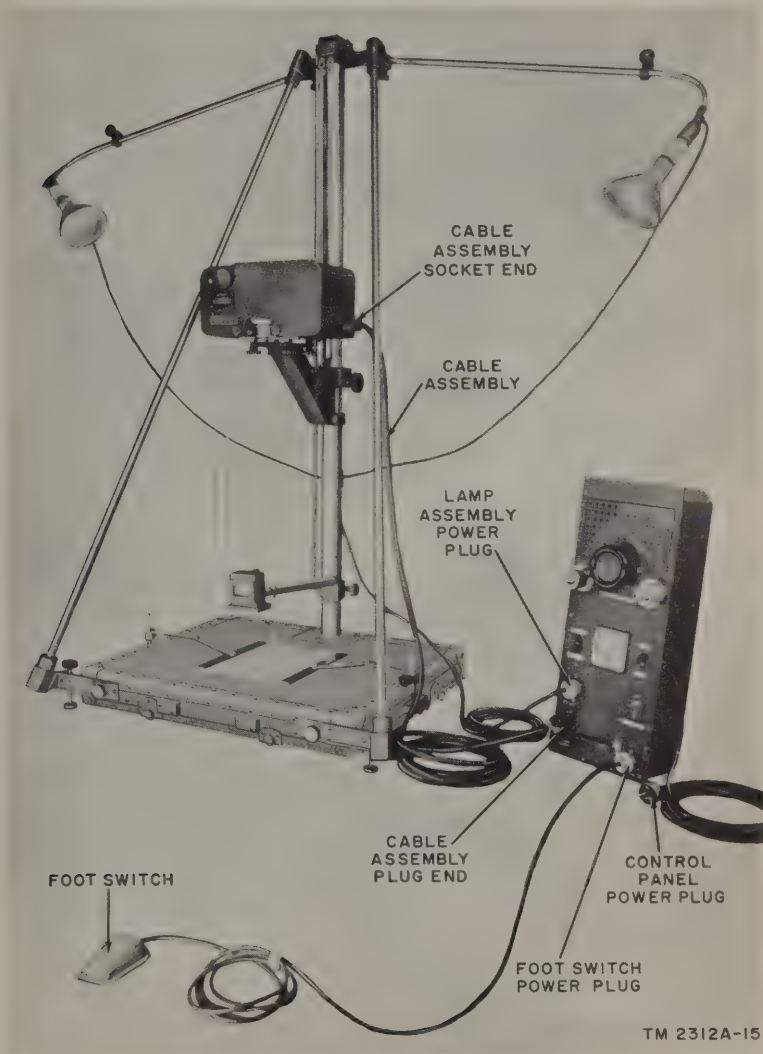


Figure 15. Electrical connections.

the plug is connected to the dc supply, a 100- to 150-watt vibrator or a rotary-type converter which has a 150-watt minimum output at 115 volts and 60 cycles must be used. The converter must be designed to operate from 100- to 120-volt dc input and must be connected to the CONVERTER receptacle on the control panel in order to utilize the dc power source. The converter draws dc from two of the prongs and in return feeds ac back to the control panel through the other two prongs.

17. Service Upon Receipt of Used or Reconditioned Equipment

When used or reconditioned equipment is received, use the table of components (par. 4) to check for completeness. Then set up the equipment to be sure that no components are missing.

a. Reconditioned equipment is seldom found to be damaged or incomplete when received. Occasionally, used equipment may be issued in incomplete or inoperable condition. When equipment appears complete and in good order, set up all components and check each for operability. Inspect the carrying cases for defective catches, handles, broken panels, and straps. Inspect the film spools for any distortion that may cause binding.

b. To check the lens and shutter assembly properly, follow the directions for focusing. The focusing accuracy of the lens system should be made by photographing suitable targets at the maximum, intermediate, and minimum reduction ratios with 35-mm film. There should be no visible out-of-focus areas when the processed film is projected. The projected picture area should cover approximately an 18 by 18-inch field. The film must be examined visually for any evidence of scratching. Any continuous scratch within the picture area, or an excessive amount of scratches which do not form a continuous scratch, but which impair desirable characteristics of the picture, are causes for rejection. Examine negatives exposed at recommended lens and shutter settings. When equipment is in good order, negatives should be sharp and clear.

c. Before use, equipment must be lubricated properly. New or reconditioned equipment is lubricated thoroughly before it is released for issue. Used equipment always should be lubricated before re-use (par. 32). Use only the lubricants specified for the equipment.

Section II. OPERATION UNDER USUAL CONDITIONS

18. Instruments and Controls

The discussion of the controls and their use is divided into three subparagraphs; control panel assembly, camera, and exposure meter. Do not attempt to operate the equipment until the function and operation of all controls are thoroughly understood.

a. Control Panel Assembly (fig. 16). The control panel of Camera PH-545A/PF, which measures 10 by 19 inches, is packed in the camera carrying case (fig. 12) but is removed from the case during operation. The top of the panel is fitted with a screen to provide ventilation for the ILLUMINATION CONTROL rheostat. The various controls and instruments located on the panel are as follows:

Instrument or control	Identification (fig. 16)	Function
ILLUMINATION CONTROL	1	Rheostat control to vary light intensity of lighting equipment.
Voltmeter	3	Indicates voltage of reflector-flood lamp circuit varied by control rheostat.
16-mm film reel gage	2	To test film take-up reels before placing them in camera.
ON-OFF switch	4	Controls power supply to control panel.
CONVERTER receptacle	5	Connection point for converter when operating on dc power source.
FOOT SWITCH receptacle	7	Connection point for foot switch assembly.
CAMERA SUPPLY receptacle	9	Point of connection for cable assembly between camera and control panel.
LAMPS receptacle	10	Point of connection for lamp assembly.
FRAME-EXPOSE switch	11	When on FRAME, the switch lights the finder lamp inside the camera. When on EXPOSE, the switch lights the reflector flood lamps.
35-mm film reel gage	12	To test 35-mm film take-up reels before placing them in camera.

b. Camera (fig. 3 and 4). All the controls for the camera are indicated below and illustrated in figures 3 and 4.

Instrument or control	Fig. ref	Function
UNEXPOSED FOOTAGE indicator	3	Indicates in 20-ft increments remaining film. Full reel indicates 100 ft; empty 0 ft.
EXPOSURE COUNTER	3	Automatically indicates number of exposures. Reset knob on bottom of camera returns counter to zero (ccw rotation).
APERTURE AND FILM FEED CONTROL	3	Controls size of projected light beam on easel to indicate the photographic field of various films.
Manual film crank	3	To advance film manually when space must be allowed between the end of one filming job and the beginning of the next. To take up the leader at the beginning of a fresh spool of film and to take up the trailer at the end of a completed spool.
Flexible steel reduction scale tape.	4	Tape is calibrated in reduction factors to correspond with similar markings on the camera lens.
Exposure counter reset knob	4	Resets exposure counter to zero.
Lens assembly	4	Index line is the alining point for the aperture scale which is calibrated from $f/4.5$ to $f/32$, and for the reduction scale calibrated from 8 through 30. One-half second fixed shutter speed.

c. Light Meter (fig. 9). The light meter, which is a photoelectric meter, is mounted as shown in figure 9. It is moved into position directly over the easel when in use. The plumb-bob, suspended from the arm, is used to determine the height of the copy on the easel in relation to the reduction factors. The calibrated meter measures the intensity of illumination of the lighting equipment. For normal operations, when the ILLUMINATION CONTROL is adjusted so that the voltmeter indicates 70 volts with white copy material, the meter (which is calibrated in arbitrary units from 0 to 15) will indicate approximately 6 units.

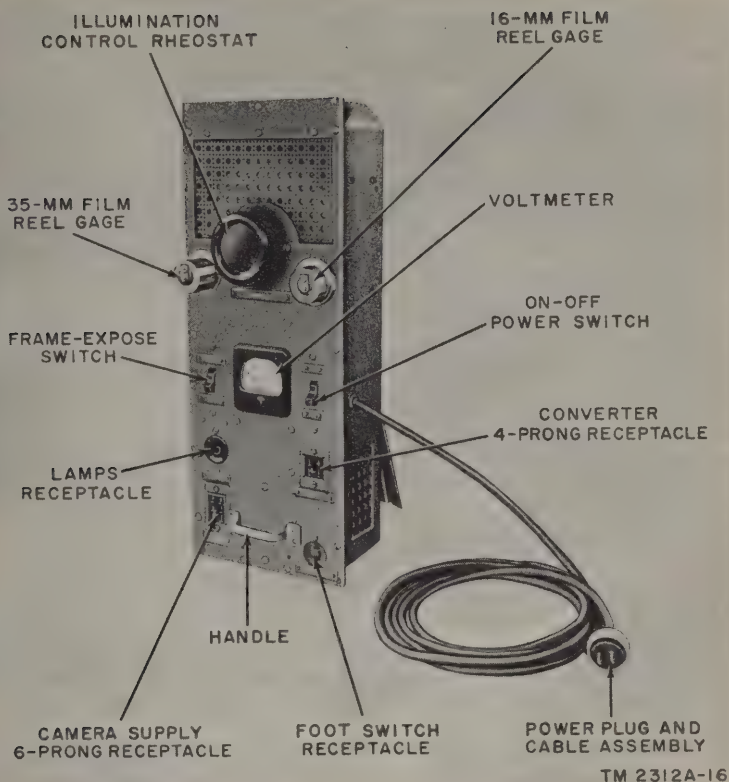


Figure 16. Control panel.

19. Preloading and Cleaning Instructions

To photograph properly, the camera and film reels must be clean and all parts must work freely. Foreign matter in a part may score the film or jam the equipment. Equipment should be cleaned at regular intervals. The finder aperture must be opened to its widest dimension so that the aperture plates are out of the way and safe from damage when cleaning the upper surface of the lens. Proceed as follows:

a. Very gently remove the dust particles from the surface of the lens; use a camel's-hair brush or an air syringe. All dust particles contain abrasive material that is as hard, or harder, than the coating on the lens surface. If the above procedure fails to remove foreign matter from the lens, slightly dampen a wad of lens cleaning tissue with liquid lens cleaner and apply it to the lens with a gentle circular motion

from the edge to the center of the glass. Dry the lens in the same manner; use a fresh piece of lens tissue. Discard lens tissue after it has once been used.

Caution: Do not use any lens tissue containing silicon. A slight deposit is left on the lens coating which may affect the performance of the lens.

b. Clean the film guides with a soft camel's-hair brush. Be sure no lint or brush hairs cling to the guides. If emulsion or dirt remains after brushing and cannot be removed by wiping with a clean, dry cloth, use an orange stick or a toothpick moistened with Solvent, Dry Cleaning (SD) to scrape off such dirt.

Note. Do not use a knife or other metal sharp-pointed tool to clean the above named parts. Avoid scratching or otherwise marring the highly polished surface of the guides.

c. The supply alarm lever which rides on the emulsion side of the film may collect a deposit of emulsion which eventually will harden and scratch the film. Clean the end of the supply alarm lever at frequent intervals to remove the accumulated emulsion.

d. The film compartment must be kept free from dust and accumulated emulsion shreds which may collect gradually at points where the film is drawn over the stationary surfaces. Carefully dust the entire interior of the film compartment with a camel's-hair brush; then blow the loosened material from the compartments with an air syringe.

e. Use a water-dampened cloth to clean the film guide roller, the film drive roller, the film alarm roller, and the film pressure roller. Dry them well.

f. Remove the platen from the platen depressor arm. Clean the grooved surface of the platen with a damp cloth to remove any particles of emulsion or gelatin adhering to the surface. Hardened accumulations of emulsion that have lodged in the grooves may be removed with an orange stick or a sliver of soft wood. While the platen is removed, clean the upper surface of the lens with a camel's-hair brush and an air syringe. The lens must not be removed from the camera, but the lower surface of the lens should be cleaned with lens tissue. The lens should be capped whenever the camera is not in use.

g. Inspect the interior of the mechanism compartment every 6 months for evidence of corrosion and dust. The dirt and dust should be loosened with a camel's-hair brush and blown out with an air syringe. Solvent (SD) will aid in removing any oily deposits. Remove the projection lamp and clean the upper surface of the condenser lens with lens cleaning tissue. Replace the lamp and remove all fingerprints with

lens tissue. Check the other mechanism components, but do not disturb any parts that operate properly and appear normal. Carefully clean the cover before reassembling it on the mechanism compartment. Inspect the reduction scale (metallic tape) for damage, kinks, and cleanliness.

h. Be sure the camera stand is kept clean and dry.

i. Check the connecting cords to see that they are clean and not coiled tightly enough to crack the insulation or kink the cords. Keep the cords away from oil and water; clean them with a damp cloth and dry them thoroughly. Examine the contact blades of the plugs to be sure that they are not corroded. Remove any traces of corrosion by polishing the blades with crocus cloth and cleaning them thoroughly with a dry cloth.

j. Clean the two carrying cases by first dusting the entire interior of the camera carrying case and the camera stand carrying case with a brush and then blowing the loosened material from the interior with an air syringe. Use a water-dampened cloth to clean the outside of the cases. Dry them thoroughly.

20. Preliminary Starting and Stopping Procedures

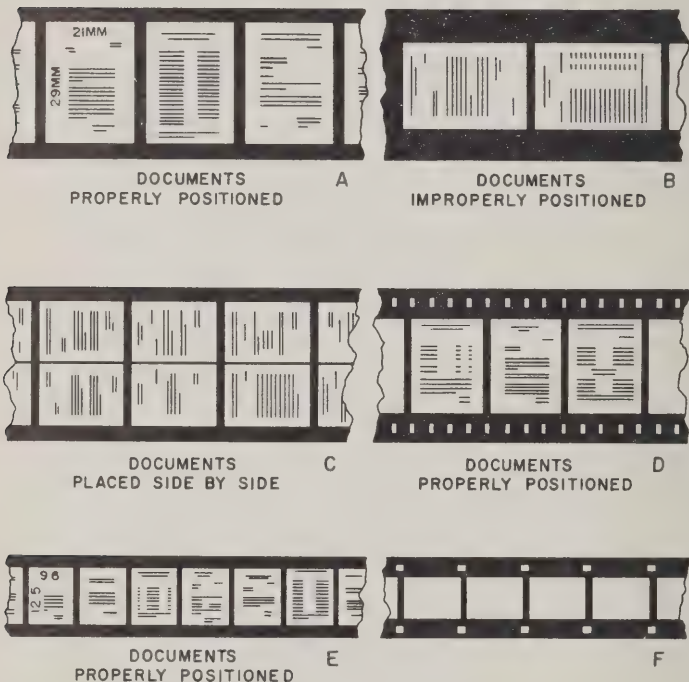
Be sure that the main power ON-OFF switch (fig. 16) on the control panel is in the OFF position. Decide which type and size of film to use and determine the reduction factor to use. Load and thread the camera with film, and then complete the final preparations for operation.

a. Film Selection. The decision as to which type and size of film to use depends on the quality of reproduction required, the manner in which the copy will be arranged for photographing, the purpose or necessity of microfilming the documents, and the economy of the microfilming operation. Use the type of film recommended by the procuring service.

- (1) *Quality of reproduction.* The amount of reduction necessary to fit the document to the film area must be determined. This operation is outlined in subparagraph *b* below. The amount of reduction will vary with the size of the film used. Thirty-five millimeter film will provide the greatest negative area and should be used when the amount of reduction is great or when the fine detail in the copy must be preserved. When the amount of reduction is not great, or when there are no fine details to be preserved, 16-mm film is recommended. The camera is designed so that from 8 to 30 diameter reductions can be obtained with either 16-mm or 35-mm film; however, the quality of work decreases as the reduction ratio increases. Documents copied at a reduction of 30 diameters will be of

poorer quality than work copied at a reduction of 15 diameters. The importance of the work involved, therefore, will govern the choice of film.

- (2) *Copy positioning considerations* (fig. 17). Since the camera photographs the full width of the film, the copy should be positioned to utilize the film area to the greatest advantage. The usable width of 35-mm film varies from 32 mm for unperforated to 24 mm for perforated film. The usable width



A AND B-35-MM FILM. 8X10 1/2-INCH DOCUMENT-REDUCTION FACTOR 9.

C-35-MM FILM. 8X10 1/2-INCH DOCUMENT-REDUCTION FACTOR 13.

D-FILM AREA LOST BY PERFORATIONS.

E-16-MM FILM. 8X10 1/2-INCH DOCUMENT-REDUCTION FACTOR 21.

F-16-MM PERFORATED FILM SHOWING LOSS OF AREA IN PERFORATIONS.

TM 2312A-17

Figure 17. Microfilming layout methods.

of 16-mm film varies from 12 mm for unperforated film to 10 mm for perforated film. Set the camera so that it will photograph the full width and length of the copy. In copy which is long and narrow, the length is critical and the complete width of the film is (unavoidably) not utilized. The width is of critical importance in most instances (A and D, fig. 17).

- (3) *Arrangement of copy.* Figure 17 illustrates several methods of arranging copy for photographing. As shown in A and D, single sheets are arranged to be photographed across the width of the film. Placed lengthwise, as in B, would be a waste of film space. Several smaller documents of the same size, or individual pages of a book, may be arranged as in C. Positions E and F illustrate the arrangement of copy planned for photographing on 16-mm film.
- (4) *Economy of reproduction.* When the amount of reduction is not great, or when there are no fine details to be preserved, 16-mm film is recommended. The arrangement of copy, as shown in figure 17, should be planned to provide as economical reproduction of documents as possible. The quantity of the reproduced material may also be a consideration.

b. Reduction Factor Determination. The amount of reduction necessary to fit the document to the film area must be determined. It depends on the size of the film and the size of the document and may be determined by mathematical calculation or by reference to the reduction factor table. Both methods are explained in subparagraphs (1) and (2) below.

- (1) *Mathematical calculation.* The reduction factor can be determined mathematically by dividing the dimension of the copy by 32 millimeters, the usable width of unperforated 35-mm film. If 16-mm film is used, divide the copy dimensions by 12 millimeters, the usable width of unperforated 16-mm film. If, for example an 8- by 10-1/2-inch document is to be copied on 35-mm unperforated film, and the document is placed as shown in A, figure 17, first convert 10-1/2 inches to millimeters. Multiply 10-1/2 by 25, since approximately 25 millimeters are equivalent to 1 inch. Then, divide the product (262.50 millimeters) by 32 millimeters (the usable width of 35-mm film) to obtain the reduction factor of 8.5. Since it is impractical to use fractions in reduction factors, the next higher factor should be chosen which, in this case, is 9. If the bar assembly and the camera lens are both set to coincide with reduction factor 9, the document will fit on the film and will be in proper focus.

- (2) *Reduction factor table.* The reduction factor table (Field Size Reduction Table) is compiled so that it will not be required to make lengthy computations. All of the possible reduction factors are given. For example, if an 8- by 10-1/2-inch document is to be copied on 35-mm unperforated film and the copy is placed as shown in A, figure 17, the nearest number that will accommodate 10-1/2-inch paper safely will be found in the column marked width. In this case, it will be the second figure in the width column or 11-1/4 inches. In line with this figure in the reduction column, the factor is given as 9. If a document to be copied is 11 by 14 inches in size, the same reduction factor could be used if the copy were placed with the 11-inch side running across the width of the film. An inspection of the projection light beam will show that the aperture should be reduced to the 14-inch length of the document in order to conserve film. A 22- by 28-inch document should be copied at a reduction ratio of 18. This aperture size will accommodate an area of 22-1/2 by 31-1/2 inches.

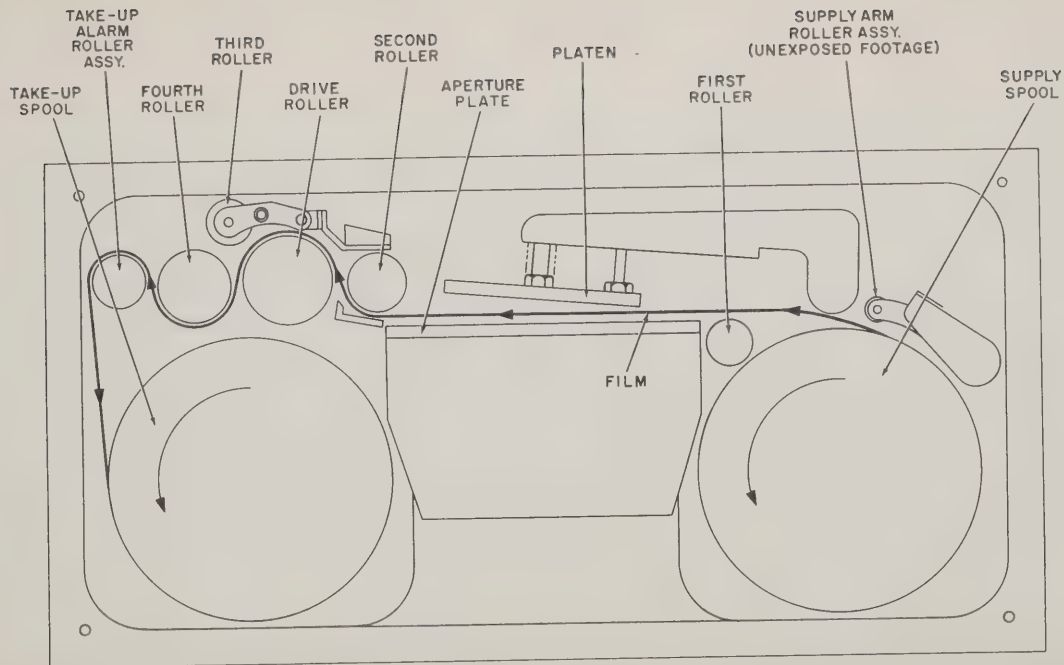
FIELD SIZE REDUCTION TABLE				
Reduction Ratio	16 MM		35 MM	
	Nonperforated Aperture Size: 1.25 x .59	Perforated 1.25 x .5	Nonperforated 1.50 x 1.25	Perforated 1.50 x .95
8	10 x 4.7	10 x 4	12 x 10	12 x 7.6
9	11.2 x 5.3	11.2 x 4.5	13.5 x 11.2	13.5 x 8.5
10	12.5 x 5.9	12.5 x 5	15 x 12.5	15 x 9.5
11	13.7 x 6.5	13.7 x 5.5	16.5 x 13.7	16.5 x 10.4
12	15 x 7.1	15 x 6	18 x 15	18 x 11.4
13	16.2 x 7.7	16.2 x 6.5	19.5 x 16.2	19.5 x 12.3
14	17.5 x 8.2	17.5 x 7	21 x 17.5	21 x 13.3
15	18.7 x 8.8	18.7 x 7.5	22.5 x 18.7	22.5 x 14.2
16	20 x 9.4	20 x 8	24 x 20	24 x 15.2
17	21.2 x 10	21.2 x 8.5	25.5 x 21.2	25.5 x 16.1
18	22.5 x 10.6	22.5 x 9	27 x 22.5	27 x 17.1
19	23.7 x 11.2	23.7 x 9.5	28.5 x 23.7	28.5 x 18
20	25 x 11.8	25 x 10	30 x 25	30 x 19
21	26.2 x 12.4	26.2 x 10.5	31.5 x 26.2	31.5 x 19.9
22	27.5 x 13	27.5 x 11	33 x 27.5	33 x 20.9
23	28.7 x 13.6	28.7 x 11.5	34.5 x 28.7	34.5 x 21.8
24	30 x 14.1	30 x 12	36 x 30	36 x 22.8
25	31.2 x 14.7	31.2 x 12.5	37.5 x 31.2	37.5 x 23.7
26	32.5 x 15.3	32.5 x 13	39 x 32.5	39 x 24.7
27	33.7 x 15.9	33.7 x 13.5	40.5 x 33.7	40.5 x 25.6
28	35 x 16.5	35 x 14	42 x 35	42 x 26.6
29	36.2 x 17.1	36.2 x 14.5	43.5 x 36.2	43.5 x 27.5
30	37.5 x 17.7	37.5 x 15	45 x 37.5	45 x 28.5

c. *Loading and Threading Film* (fig. 18). Proceed as follows to load and thread film into the camera.

- (1) Open both doors of the camera film compartment. Remove a can of unexposed film from its carton and remove the adhesive tape from the can. With all lights off, lift the film from the can and pull off the paper tape which binds the film. Remove all traces of tape from the film. Save the carton, can, and black paper to rewrap the film after it has been exposed.

Caution: Film used with this camera is extremely sensitive to light. Be very careful when handling it so that it does not unwind from the time a film can is opened until the film is placed in the camera and the doors are closed.

- (2) Place the loaded film spool over the supply spindle. Lift the supply arm roller assembly (part of unexposed footage indicator arm) to allow the film spool flange to pass. Be sure that the hole near the spool center fits over the drag stud of the spindle brake disk. If the reel does not fit evenly on the disk, remove it and replace it on the spindle with the other side out. It will fit only one way. Allow the supply alarm roller assembly to move back and rest on the film in the spool. The arm will ride on the surface of the film. When the full 100-foot roll is in position, the unexposed footage indicator (fig. 3) will indicate 100 feet. The indicator, calibrated in 20-foot increments, from 0 to 100, will register zero when the film supply is exhausted. The unexposed footage indication is governed by the diameter of the film supply on the spool and is a rough (20-foot) indication of the film supply remaining. When the film supply is exhausted, the alarm buzzer will sound to indicate this condition.
- (3) For film-threading operations, refer to figure 18. Unroll about 18 inches of film. Note that the supply spool unwinds in a counterclockwise direction. Pass the film leader over the first guide roller, between the platen and the aperture plate, under the second roller, and over the drive roller. The third roller, which is under spring tension, holds the film in contact with the drive roller to provide positive feeding of the film. The film passes around and under the fourth roller and around the take-up alarm-roller assembly, which is under spring tension. When the film is feeding properly through the camera, the tension of the film overcomes the tension of the spring. If the film should break, the spring tension will cause the assembly to actuate the alarm. Close and lock the



TM 2312A-18

Figure 18. Loading and threading film, diagram.

supply cover of the film compartment. Test the take-up spool with the reel gage (fig. 16) by placing the gage between the flanges and moving it completely around the spool. Do not force it against the core of the spool. If, at any point, the gage is held so tightly between the flanges that it does not fall out of its own weight, use another spool which tests satisfactorily. Insert the film leader into the slot in the take-up spool. Revolve the spool several turns in a counterclockwise direction. Place the spool on the take-up spindle so that the two holes on the side of the spool flange engage the two driving pins. Close and lock the take-up cover to the film compartment. If the doors do not close easily, check the supply and take-up spool. Do not force the doors.

- (4) Move the **FRAME-EXPOSE** switch on the control panel (figure 16) to the **EXPOSE** position, and turn the **ON-OFF** switch to **ON**. Press the foot switch momentarily to make one exposure. During the exposure, the alarm bell should ring because the film is loose around the alarm roller. Push in the hand crank on the camera door and give it eight counterclockwise turns to wind up the leader. Again actuate the foot switch to make another exposure. During this exposure, the alarm bell should not ring because the film now has been pulled tightly around the alarm roller. The camera is ready for operation with the exception of a few final adjustments. Turn the **ON-OFF** switch to the **OFF** position.

d. Final Preparations. Turn the exposure counter reset knob (fig. 4) until all the zeros are in the window. To set the counter to any figure other than zero, turn the reset knob backward until the shaft locks into the zero position before attempting to operate the counter.

21. Equipment Operation

The camera is designed to operate in either the vertical or horizontal position, in order to photograph documents of various sizes and shapes. Subparagraph *a* below covers the operation of the equipment in the vertical position, and subparagraph *b* contains the information necessary for operating the equipment in the horizontal position. Only operations which differ from vertical operation or which are unique to horizontal operation are included in subparagraph *b*. Where the operations are the same, a reference is made to the appropriate material.

a. Vertical Operation (fig. 1). The operation of the camera, which is capable of photographing in the vertical position any document up to 20 by 27 inches, is outlined below.

- (1) *Initial procedure.* Make sure the ON-OFF switch (fig. 16) on the control panel is in the OFF position. Check to see that all the necessary electrical connections (par. 16) are made between the camera, control panel, and power supply. Make sure that the camera is mounted securely in the vertical position as instructed in paragraph 15a.
- (2) *Placing document.* Place the document which is to be copied on the easel. Center it approximately under the camera lens and adjust the two copyholders to keep the copy in position. If the copy consists of a single sheet of paper, make sure that it is flat on the easel. If the pages of a book are being photographed, flatten the pages as much as possible and, if necessary, add weights or cellulose tape to hold down the edges.
- (3) *Scanning procedure.* The camera is provided with a scanning arrangement so that the operator may observe, throughout the entire range of reduction factors, the exact area to be photographed. An externally controlled, manually operated masking device also is provided. The masking device is synchronized with the scanning arrangement to indicate the exposed film area. It is synchronized with the film transport mechanism so that the length of the film being advanced will be in correct relationship to the unmasked area to be photographed. Light the projection lamp inside the camera to project a beam of light on the easel by turning the FRAME-EXPOSE switch (fig. 16) on the control panel to the FRAME position and the ON-OFF switch to the ON position. Manipulate the APERTURE AND FILM FEED CONTROL located on the right end of the camera (fig. 3) to adjust the size of the light pattern on the easel. The cord hanging from the control facilitates the focusing operation. The two sets of guide lines, which are part of the light pattern, denote the field vision for 16-mm and 35-mm film. The larger area indicates the 35-mm film field of vision; the smaller area indicates the 16-mm film field of vision. Center the document within the rectangle of light which corresponds with the film being used in the camera. Manipulate the APERTURE AND FILM FEED CONTROL to adjust the size of the light pattern to include all of the copy on the easel. If manipulating the APERTURE AND FILM FEED CONTROL does not expand the light pattern to include all of the copy, or if it is not possible to decrease the size of the light pattern to include just the copy on the easel, either raise or lower the camera to establish the correct light pat-

tern size. Loosen the knob on the camera mounting bracket (fig. 13); then position the camera to establish the desired light pattern adjustment. Tighten the knob to secure the camera position. Readjust the **APERTURE AND FILM FEED CONTROL** to establish the correct size light pattern on the easel. If the document cannot be placed conveniently on the easel because of its size, refer to subparagraph *b* below for information on horizontal operation of the camera equipment.

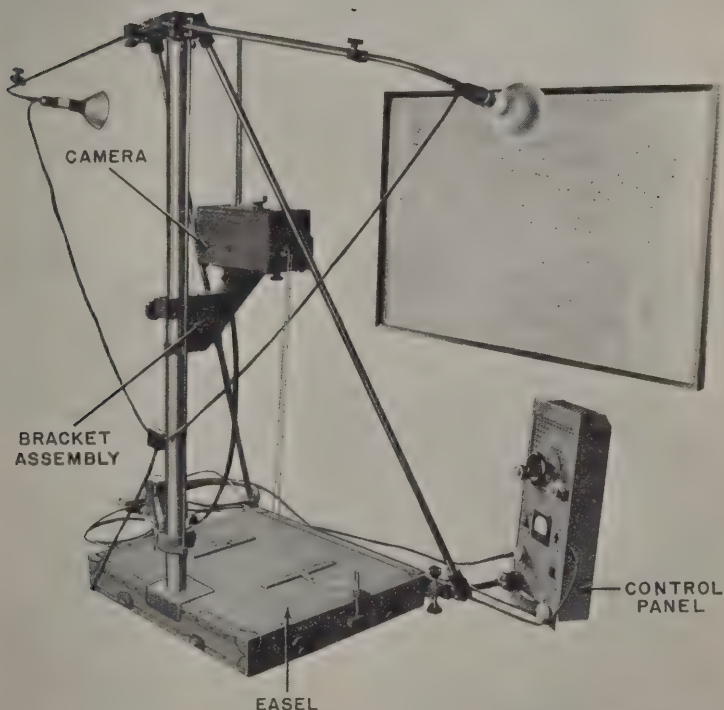
- (4) *Reduction factor settings.* Determine the reduction factor for the document to be photographed as outlined in paragraph 20*b*. With the document in position, swing the light meter over the copy. The suspended plumb-bob should just touch the surface of the copy. If the plumb-bob is either too close to the copy or does not make contact with it, adjust the clamp assembly (9, fig. 9) up or down on the post assembly until the plumb-bob just touches the copy; then secure the clamp at this point. The light meter (14, fig. 9) will then be at the proper distance from the copy. Move the camera up or down on the post assembly to align the pointer on the left side of the camera mounting bracket with the reduction factor number on the calibrated bar (fig. 16). Tighten the knob to secure the camera in this position. Turn the reduction scale on the lens assembly (fig. 7) to align the reduction factor number with the index line. This completes the reduction factor settings for the document to be copied. If the other documents are of the same size, the same reduction factor will be used; therefore, it will not be necessary to change the two settings. However, if the documents are of a different size, determine the new reduction factor and establish the necessary settings. To microfilm large numbers of documents of varying sizes, the operator should group the documents of the same size together to minimize the number of individual setups.
- (5) *Illumination procedure.* The best photographic results are obtained when the copying operation is conducted in a photographic darkroom or in a room where the natural lighting is subdued. It is necessary to have access to switches for any artificial lights in the room. Turn the **FRAME-EXPOSE** switch (fig. 16) on the control panel to the **EXPOSE** position; then turn the **ON-OFF** switch to the **ON** position. Shut off all other artificial lights in the room, and control any natural lighting. Adjust the **ILLUMINATION CONTROL** until the voltmeter indicates 70 volts. Cover the easel with a piece of

white paper, and then position the light meter (fig. 9) over the paper so that the plumb-bob just touches the paper. The light meter, which is calibrated from 0 to 15 units, should indicate approximately 6 scale units. Without changing the ILLUMINATION CONTROL setting, move the light meter to each corner and to the center of the easel and note the meter indications at each location. The readings should remain approximately the same to indicate a uniform illumination over the entire surface of the copy area. If uneven illumination is indicated, adjust the position of the lamps (fig. 9) until the correct illumination is provided. Unequal lighting results in unequal density of the developed film. The flood lamps should be kept and used in pairs, so that both lamps in each set will have the same amount of service. For normal copying operations with a white background, a reading of 70 volts on the voltmeter (fig. 16), and the associated reading of 6 scale units on the light meter (fig. 9) and an aperture scale setting of f/8 should give satisfactory results when the reduction scale (fig. 7) is set to the proper reduction factor. For copy that is lighter or darker than the copy used for normal copying operations, the aperture scale (fig. 7) and/or the ILLUMINATION CONTROL (fig. 16) will have to be adjusted accordingly. The larger the aperture scale setting, the smaller the lens opening; consequently, the amount of light admitted by the lens at a fixed shutter speed is decreased. For each increment the aperture scale setting is increased (lens opening decreased), the amount of flood lamp illumination must be doubled to get the same negative density as for the normal exposure. A series of test strips at the various aperture scale settings and under varied light conditions of several types of copy, should be made to establish the best combination of aperture settings and light conditions for microfilming the various documents.

- (6) *Exposure sequence.* With the light switch turned to the EXPOSE position and the necessary adjustments (subpar. 1 through 5 above) completed, the photographing operation may start. Actuate the foot switch (fig. 15) to make a single exposure. The foot switch should be depressed just long enough to start the camera cycle of operation. In operation, the functioning of the camera is distinctly audible. The foot switch should be released as soon as the drive motor in the camera is heard. When the foot switch is actuated, a slight hum will be audible, followed by the sound of the shutter opening and closing. The hum will continue until the film is advanced; then the camera will become completely silent.

It remains silent until the foot switch is actuated to start another cycle of operation. During normal operation with film in the camera, the buzzer will not sound. If the buzzer does sound, check the footage indicator on the camera. If it registers empty, turn the ON-OFF switch to OFF and reload the camera as described in paragraph 20c. After the exposure has been made, and the drive motor has advanced the film automatically, remove the document from the easel and place the second document in position. Repeat the sequence of operations outlined in the subparagraphs above until all the documents have been photographed or until the warning buzzer indicates that the film supply has been exhausted.

- (7) *Spacing sequences.* If the work is completed before the film supply is exhausted and another series of documents is to be photographed on the same roll of film, turn the winding



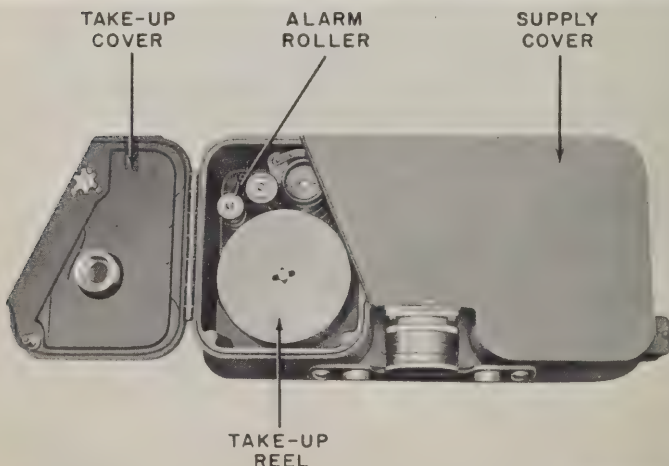
TM 2312A-19

Figure 19. Horizontal operation.

(manual) crank (fig. 3) one complete revolution to advance the film approximately 4 inches. This will leave a blank space to separate the two series.

b. Horizontal Operation (fig. 19). The camera, is capable of photographing any document up to 37 by 42 inches in the horizontal position. The procedure is outlined below.

- (1) *Initial procedure.* Be sure the ON-OFF switch on the control panel (fig. 16) is in the OFF position. Check to see that all the necessary electrical connections (par. 16) are made between the camera, control panel, and power supply. Be sure that the camera is mounted securely in the horizontal position (par. 15b).
- (2) *Positioning documents.* Mount the copy on a wall, bulkhead, or large support, such as illustrated in figure 19. When setting up the camera for horizontal operation, the optical axis of the camera must be perpendicular to the mounted copy. Using a tape measure, measure from the right front corner of the easel to the wall; then measure from the left front corner of the easel to the wall. When these two measurements are equal, the front edge of the easel and the wall should be parallel; therefore, the optical axis of the camera is perpendicular, both horizontally and vertically, to the wall. Another method to establish this perpendicular reference of the camera and wall is to project the light pattern on the wall. The opposite sides of the rectangular light pattern



TM 2312A-20

Figure 20. Removing exposed film.

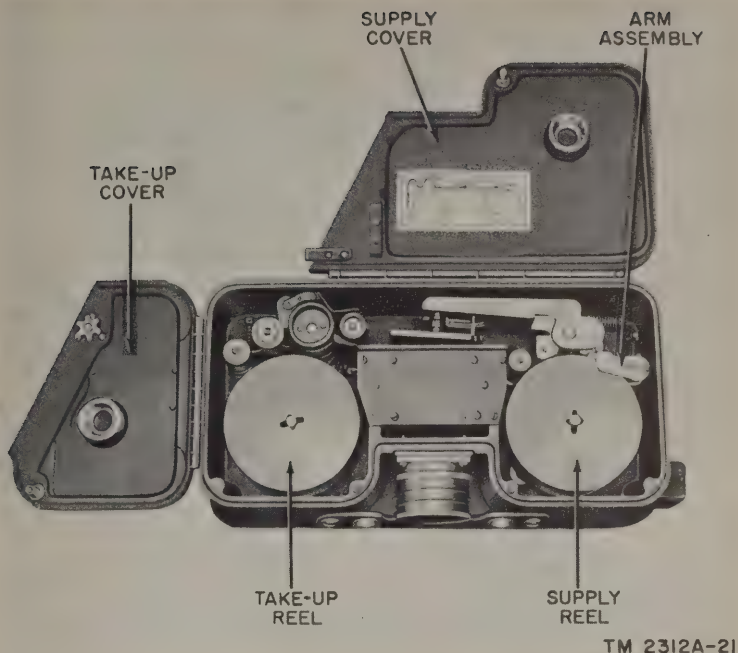


Figure 21. Unloading camera.

should be equal. If they are not, it indicates there is distortion. Reposition the camera to correct this distortion.

- (3) *Reduction factor settings.* Determine the reduction factor for the document to be photographed as outlined in paragraph 20b. Pull out the steel reduction tape from the bottom of the camera (fig. 3) and extend it until it touches the mounted document. Read the reduction factor on the steel reduction scale at the point where it leaves the camera. If the reduction factor coincides with the factor established by mathematical calculation or by reference to the table, adjust the reduction scale on the lens assembly to align the reduction factor number with the index line. If the reduction factor read on the steel reduction scale is not the same as the factor previously established, move the camera stand either closer to, or farther from, the wall until the steel reduction tape indicates the proper value. Be sure the perpendicular reference between the camera and the wall is correct, then adjust the reduction scale on the lens assembly to align the reduction factor number with the index line.

- (4) *Scanning procedure.* This operation is similar to that established for vertical operation (subpar. a(3) above).
- (5) *Illumination procedure.* This operation is similar to the procedure outlined in subparagraph a(5) above. Remove the meter from its mounting and hold it approximately 4 inches from the document at each corner of the easel. Position the lamps so that uniform, light-meter readings are taken at each corner. Without changing the setting of the ILLUMINATION CONTROL, place the light meter approximately 4 inches from the document with the cell window of the meter toward the document. Take a meter reading, then set the aperture scale on the lens assembly (fig. 7) to the proper number which corresponds with the light-meter reading. The camera is now set for correct exposure.
- (6) *Exposure sequence.* Refer to subparagraph a(6) above.
- (7) *Spacing sequence.* Refer to subparagraph a(7) above.

22. Stopping Procedure

a. *Unloading Camera When Film is Completely Exhausted* (fig. 21).

- (1) When the warning buzzer sounds and the footage indicator registers empty, turn the winding crank at least eight times to be sure that all of the film is wound on the take-up spool.
- (2) Release the latches and open both covers of the film compartment.
- (3) Remove the take-up reel. Be sure that the film is kept tightly wound on the reel.
- (4) Wrap the film in black paper; then place it in the film can. Place the can in its original carton.
- (5) Mark the necessary identification on the outside of the carton and send it to the processing laboratory for developing.

b. *Unloading Camera When Film Remains on Supply Reel* (fig. 20).

- (1) Turn the film winding crank eight times to provide a film leader for the spool.
- (2) Open the take-up cover of the film compartment. Do not open the supply cover.
- (3) Cut the film between the film alarm roller and the take-up spool. Be sure to keep the film on the spool from unwinding.

- (4) Remove the take-up spool and wrap it as described in paragraph 22a(4).
- (5) Place an empty take-up spool on the take-up spindle. Attach the film to the spool by inserting it in the slot and turning the spool approximately two revolutions counterclockwise.
- (6) Close the film take-up cover and turn the film winding crank three complete revolutions. The camera is now ready for further operation.

c. Extended Shutdown. When the equipment is to be shut down for long periods of time, it should be disassembled and repacked.

- (1) Remove the exposed film from the camera. Refer to subparagraph 22a and b.
- (2) In subdued light, remove the unexposed film from the camera. Be careful to hold the film tightly on the spool to avoid fogging. Wrap the film in black paper, place it in the film can, and place the can in its carton. Note on the outside of the carton the approximate number of feet on the spool, as indicated by the footage indicator before the film was removed from the camera. Allow approximately 3 feet of film for the film leader.
- (3) Disassemble the equipment and repack it in the carrying cases.

d. Limited Shutdown. When the equipment is to be shut down for a few hours or for overnight, it need not be disassembled, but proceed as follows:

- (1) Remove the exposed film from the camera as described in subparagraphs a and b above.
- (2) Disconnect the line cord from the control panel (fig. 16) and from the power source receptacle. Disconnect the foot switch from the power source. Disconnect the lamp feeder cord from the power source and disconnect the interconnecting cord from the camera and from the power source.
- (3) Coil all the cords and place them on the easel.
- (4) Move the camera carrying case near the tripod and cover the camera, camera stand, and camera carrying case with cloth or paper to protect the components from dust.

Note. The unexposed film need not be removed from the camera, if the equipment is to be shut down for a very short period of time.

Section III. OPERATION UNDER UNUSUAL CONDITIONS

23. Arctic Climate Operation

The lubricants used on the equipment are resistant to cold and will not noticeably retard operation of mechanical parts. However, condensation of moisture on the camera and film reels must be avoided. Crystals of frost may jam mechanical parts of the shutter assembly and form translucent deposits on the lens.

a. Do not breathe directly on the equipment during cold weather. Even slight deposits of condensed, frozen vapor on the lens surfaces will seriously impair the clarity of exposed film.

b. Cover the components when equipment is left set up overnight during cold weather and when it is not in use during periods of high humidity accompanied by below-freezing temperatures. Deposits of frost may cause the shutter to jam open and thereby spoil large quantities of film. When this occurs, copy must be rephotographed.

c. Ice crystals may form in the equipment when it is brought into a warm room from a cold location and then removed to cold surroundings while moisture still adheres to the metal surfaces. Store the equipment in a cool place during cold weather, and wrap or cover it to protect it from humidity.

24. Desert Operation

Aridity and dust conditions present special problems. Clean the equipment frequently when operating in desert areas.

a. When operating the camera, examine the front lens element frequently and dust it with a camel's-hair brush to remove dust deposits. If the film reels remain in place in the film compartment, dust will have little opportunity to collect on the exposed surface of the rear lens element.

b. The film compartment is closed tightly and resists the entrance of dust. Do not open the film compartment unless it is necessary to remove or reload the film reels. When the film compartment is open for the removal or reloading operation, dust the interior if necessary.

c. The mechanism compartment of the camera also is subject to dust, especially where lubricants are present. However, dust deposits rarely will be great enough to require cleaning more than once a week. As a precaution, when operating under extreme dusty conditions, remove the back cover daily to determine if the accumulation of dust is excessive. If daily checking is not justified at the end of the week,

eliminate it and continue with the weekly investigation. Before using the camera, use a soft-bristle brush to clean off any sand or other foreign matter accumulated on the surface of the camera or camera stand. Use a camel's-hair brush to clean the pressure plate, aperture plate, sprockets, and lens of the camera. Do not use lens tissue to clean the lens unless it has been dusted with a camel's-hair brush. The lens will scratch if cleaned with tissue before dusting it. Do this cleaning indoors or under cover to be sure that no dust remains on the equipment when it is stored.

25. Operation in Tropical Climates

Equipment used in tropical climates is subject to high humidity and the rapid and profuse growth of fungus. The direct effects of hot, dry weather, on the other hand, are negligible. Humidity plus heat is responsible for the growth of fungus. Like all painted surfaces, tropicalized surfaces wear off and must be refinished. While operating equipment in the tropics, handle the surfaces as little as possible. Use a cloth to wipe off perspiration, deposits of dirt, or other foreign matter after each period of use. In climates of high humidity, such as the tropics, take special care of the aperture and pressure plates, to prevent corrosion of the polished surfaces. Inspect the camera for traces of fungus, mold, mites, and metallic corrosion. Remove all fouling immediately. When not in use, store the camera equipment in a reasonably dry, cool place.

26. Salt-water Area Operation

Operation of equipment in salt-water area only slightly increases the rate of metal corrosion, predominantly to aluminum parts. Equipment recently and properly coated with weatherproofing finishes and fungicide is sufficiently resistant to the salt-air effect. Deposits of moist salt, even in very small quantities, will conduct electricity. Insulation of the lighting and the control systems may become sufficiently impregnated with salt and moisture to cause slight leakages of current into metal parts of equipment. Current flow into the camera case may be sufficient to cause persons who touch the case to experience a slight shock, but it is seldom dangerous. To prevent shock, ground the equipment by attaching a wire to the case and to ground metal.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE

INSTRUCTIONS

Section I. ORGANIZATIONAL TOOLS AND EQUIPMENT AND PREVENTIVE MAINTENANCE SERVICES

27. Tools and Materials Used with Equipment

No tools are supplied with Camera PH-545A/PF. When the equipment is disassembled, ordinary hand tools normally used for the repair of photographic equipment may be used. No materials are issued or supplied with the equipment. For routine preventive maintenance work, the items required are listed in the chart below:

Item	Use	SigC Stock No.
Cloth, lint-free	Clean surfaces of case, lamps, and male contacts of receptacles and plugs.	6Z1989
Solvent, Dry Cleaning (SD)	Clean surfaces.	6G236.5
Carbon tetrachloride	Clean electrical contacts.	CML-122593 (chemical)
Lens tissue	Clean lenses.	8A2559
Liquid lens cleaner	Clean lenses.	8A819
Camel's-hair brush	Clean lenses and interior of camera.	6Z1372
Blower, watch, hand	Clean interior of camera.	3B4151

Caution: Emery cloth, sandpaper, or similar abrasive materials must not be used to clean the equipment. Use only the cleaning fluids specified. Do not use gasoline as a cleaning agent for the camera. Repeated contact of carbon tetrachloride with the skin or prolonged breathing of the fumes is dangerous. Make sure adequate ventilation is provided.

28. Definition of Preventive Maintenance

Preventive maintenance means making systematic checks and adjustments at regular intervals to keep equipment operating at top efficiency. It is not the same as trouble shooting or repair. The purpose of preventive maintenance is to prevent breakdowns and, therefore, the need for repair. The purpose of trouble shooting and repair is to locate and correct existing defects. The importance of preventive maintenance cannot be over-emphasized. Failure or inefficient operation of one piece of the equipment may cause the failure of the entire photographic system. It is vitally important, therefore, that operators and repairmen properly maintain their equipment.

29. Detailed Instructions

a. Cleanliness. Cleanliness of the camera is absolutely essential. Clean and dust all parts of the camera as instructed in paragraph 19.

b. Lubrication. All moving parts of Camera PH-545A/PF are lubricated by the manufacturer during assembly. New equipment needs no further lubrication when it is received. However, moving parts should be lubricated periodically with Oil, Lubricating, Preservative, Special (PL Special) as instructed in paragraph 34.

c. Precautions. The camera is a complex precision instrument. Clean it carefully to avoid bending any of the connecting levers in the mechanism compartment. Do not remove the cover of the mechanism compartment unless the room is reasonably free from dust. When cleaning the upper surface of the camera lens, open the finder aperture to its widest dimension so that the aperture plates are out of the way and safe from damage.

30. Preventive Maintenance Techniques

The following checklist contains information on preventive maintenance procedures, specifically, what to check, when to check, how to check, and precautions to be taken when making the check:

30. Preventive Maintenance Techniques (contd)

Item No.	What to check	When	How to check	Special instructions, precautions, corrections
1	Equipment for completeness.	D ^a	Check equipment against list in paragraph 4.	Secure replacements for missing parts.
2	Carrying cases.	D	Inspect cases for dirt, oil, cracks, defective straps, broken snap fasteners, scratched or chipped paint, and stripped or loose mounting screws.	Clean cases, refinish if necessary; repair or replace defective hardware.
3	Camera exterior.	D	Inspect for dust, dirt, lint, moisture, corrosion, rust, oil, grease, cracks, chips, and loose or missing screws.	Clean camera (par. 19), remove corrosion; refinish, if necessary, or touch up. Tighten or replace screws.
4	Lens and lens mounting.	D	Inspect lens mounting barrel for corrosion, roughness, worn spots, binding threads. Inspect lens for dust, dirt, fingermarks, moisture, scratches, and cracks.	Remove corrosion, and if roughness and binding is excessive, replace. Use a camel's-hair brush and lens tissue to clean lens. Replace if scratched or cracked.
5	Camera interior (film compartment).	D	Inspect for film chips, corrosion, mildew, fungus, moisture, dust, and oil and emulsion deposits.	Clean (par. 19).
6	Camera interior (mechanism compartment).	W ^h	Operate the camera for normal operation. Listen for any unusual sounds and watch for irregularities in operation. Remove cover and check for cleanliness.	Clean (par. 19).
7	Lighting equipment.	W	See that reflector flood lamps light and are mounted. Check for dirty, corroded lamp bases and holders.	Replace defective bulbs, clean dirty lamp base, and replace if cracked or defective.

8	Cables and connectors.	W	Check for abrasions, cuts, and breaks in insulation. Examine connectors for loose connections, corrosion, mildew, and bent contacts.	Repair insulation with friction tape. Tighten or solder loose connections as required. Clean and straighten male contacts. Increase tension of loose female contacts.
9	All controls.	W	Check all controls for free movement, and normal indications.	Check switches for positive action, and security of mounting.
10	Camera stand.	W	Inspect for bends, nicks, dents, stripped threads, and corrosion.	Clean (par. 19), repair or replace units which are bent, dented, stripped, or nicked. Remove corrosion.
11	Film rollers, supply arm lever, platen, projection lamp.	W	Check for operation and cleanliness. Check platen for proper mounting. Inspect bulb for cleanliness and proper mounting. See that film rollers turn freely.	Clean film rollers, platen, and supply arm lever with a water-dampened, lint-free cloth. Clean bulb with lint-free cloth.
12	All mounting points, knobs, screws, etc.	W	Check all mounting points of connection.	Tighten to a hand-tight fit all knobs, screws, etc.
13	Film spools.	W	Inspect film spools for deformation, or bent flanges.	Use film spool gages to reset flanges, or replace if damaged excessively.

^aD — Daily

^bW — Weekly

31. Use of Preventive Maintenance Forms

(figs. 22 and 23)

a. The decision as to which items on DA Forms 11-254 and 11-255 are applicable to this equipment is a tactical decision to be made in the case of first echelon maintenance by the communication officer/chief or his designated representative, and in the case of second and third echelon maintenance, by the individual making the inspection. Instructions for the use of each form appear on the reverse side of the form.

OPERATOR FIRST ECHOLON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT STILL CAMERA SET									
INSTRUCTIONS: See other side									
EQUIPMENT NOMENCLATURE					EQUIPMENT SERIAL NO.				
LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; ① Defect corrected. NOTE: Strike out items not applicable.									
DAILY									
NO.	ITEM	CONDITION							
		S	M	T	W	T	F	S	
1	INSPECT FOR COMPLETENESS OF EQUIPMENT: LENS, CARRYING CASE, ACCESSORIES, TECHNICAL MANUALS, ALL RUNNING SPARE PARTS. PAR 4								
2	CLEAN CARRYING CASE OF DIRT AND OIL. (Outdoor use). PARS. 19j, 30(2)								
3	INSPECT CARRYING CASE AND STRAPS FOR CRACKS, WEAR, BROKEN SNAP FASTENER, FUNGUS. (Outdoor use). PAR. 30(2)								
4	INSPECT EXTERIOR OF CAMERA FOR DUST, DIRT, LINT, MOISTURE, CORROSION, RUST, OIL, GREASE, CRACKS, CHIPS. PAR. 30(3)								
5	CLEAN LENS AND LENS MOUNTING OF DUST, DIRT, FINGERMARKS, AND MOISTURE, USING A CAMEL'S HAIR BRUSH AND LENS TISSUE. (Do not use alcohol, polishing material or solvents, or rub lens with fingers). PAR. 19d								
6	INSPECT LENS MOUNTING BARREL FOR CORROSION, ROUGHNESS, WORN SPOTS, BINDING THREADS. PAR. 30(4)								
7	INSPECT ACCESSORY CLIP FOR DEFORMED RAILS AND STOP LUG.								
8	INSPECT CAMERA INTERIOR FOR FILM CHIPS, DUST, CORROSION, MILDEW, FUNGUS, MOISTURE, DUST, OIL. PARS. 19b,c,d,e,f,g, 30(5,6)								
9	INSPECT ALL CONTROLS AND KNOBS FOR FREE MOVEMENT. PAR. 30(9)								
10	INSPECT FILTERS AND PEEPSIGHTS FOR LINT, DUST, DIRT, MOISTURE.								
WEEKLY									
NO.	ITEM	COND- ITION	NO.	ITEM	COND- ITION				
11	TIGHTEN TO A HAND-TIGHT FIT - ALL LOOSE ASSEMBLY AND MOUNTING SCREWS. PAR. 30(12)		15	INSPECT FLASHGUN BATTERIES FOR CORROSION, BULGING.					
12	INSPECT FLASH GUN CONTACTS FOR CORROSION, RUST, PITTING, DIRT.		16	INSPECT FILM SPOOLS AND MAGAZINES FOR DEFORMATION, BENT FLANGES. PAR. 30(13)					
13	INSPECT LENS FOR PROPER SEATING IN LENS MOUNT. PAR. 30(4)		17	CLEAN TRIPOD OF DIRT, GRIME, RUST, MOISTURE. PARS. 19h, 30(10)					
14	INSPECT VIEWFINDER FOR FIRM MOUNTING IN PROPER POSITION.		18	SET SHUTTER TO PROPER POSITION WHEN NOT IN USE.					
19 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.									

DA FORM 11-254 1 MAY 51
REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM 2312A-22

Figure 22. DA Form 11-254.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT STILL CAMERA SET

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE

EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; ① Defect corrected.
NOTE: Strike out items not applicable.

NO.	ITEM	COND.	NO.	ITEM	COND.
1	INSPECT FOR COMPLETENESS OF EQUIPMENT: LENS, CARRYING CASE, ACCESSORIES, TECHNICAL MANUALS, ALL RUNNING SPARE PARTS. PAR 4		16	INSPECT FILM SPOOLS AND MAGAZINES FOR DEFORMATION, BENT FLANGES. PAR 30 (13)	
2	CLEAN CARRYING CASE OF DIRT AND OIL (Outdoor use). PAR 19, 30 (2)		17	CLEAN TRIPOD OF DIRT, GRIME, RUST, MOISTURE. PAR 19h, 30 (10)	
3	INSPECT CARRYING CASE AND STRAPS FOR CRACKS, WEAR, BROKEN SNAP FASTENER, FUNGUS (Outdoor use). PAR 30 (2)		18	SET SHUTTER TO PROPER POSITION WHEN NOT IN USE.	
4	INSPECT EXTERIOR OF CAMERA FOR DUST, DIRT, LINT, MOISTURE, CORROSION, RUST, OIL, GREASE, CRACKS, CHIPS. PAR 30 (3)		19	INSPECT FOR PROPER TENSION: SHUTTER, EYEPiece, CURTAIN SPRINGS, CURTAIN WINDING GEAR.	
5	CLEAN LENS AND LENS MOUNTING OF DUST, DIRT, FINGERMARKS, AND MOISTURE, USING A CAMEL'S HAIR BRUSH AND LENS TISSUE. (Do not use alcohol, polishing material or solvents, or rub lens with fingers). PAR 19g		20	INSPECT FOR LIGHT LEAKS - SHUTTER, BELLows, LIGHT-LOCK DOOR AND COVER.	
6	INSPECT LENS MOUNTING BARREL FOR CORROSION, ROUGHNESS, WORN SPOTS, BINDING THREADS. PAR 30 (4)		21	INSPECT FOR PROPER SEATING - COVER LOCKING STUD.	
7	INSPECT ACCESSORY CLIP FOR DEFORMED RAILS AND STOP LUG.		22	INSPECT CURTAIN FOR STRETCHING DUE TO WEATHER.	
8	INSPECT CAMERA INTERIOR FOR FILM CHIPS, DUST, CORROSION, MILDEN, FUNGUS, MOISTURE, DUST, OIL. PAR 19b,c,d,e,f,g, 30 (5,6)		23	INSPECT GEARS FOR BROKEN TEETH, POOR MESHING.	
9	INSPECT ALL CONTROLS AND KNOBS FOR FREE MOVEMENT. PAR 30 (9)		24	TIGHTEN ALL LOOSE ASSEMBLY AND MOUNTING SCREWS TO A HAND-TIGHT FIT.	
10	INSPECT FILTERS AND PEEPSIGHTS FOR LINT, DUST, DIRT, MOISTURE.		25	INSPECT FLASH SYNCHRONIZER FOR PROPER OPERATION.	
11	TIGHTEN TO A HAND-TIGHT FIT - ALL LOOSE ASSEMBLY AND MOUNTING SCREWS. PAR 30 (12)		26	INSPECT SLOW SPEED DIAL FOR ACCURACY.	
12	INSPECT FLASH GUN CONTACTS FOR CORROSION, RUST, PITTING, DIRT.		27	INSPECT TRIPOD FOR BINDING OR STRIPPED MOUNTING THREADS, SPLIT OR BROKEN WOOD, LOOSE OR MISSING SCREWS, FREE MOVEMENT OF TILT-TOP HEAD.	
13	INSPECT LENS FOR PROPER SEATING IN LENS MOUNT. PAR 30 (4)		28	DISASSEMBLE LENS MOUNTING AND CLEAN INTERIOR OF LENS AND LENS MOUNTING BARREL.	
14	INSPECT VIEWFINDER FOR FIRM MOUNTING IN PROPER POSITION.		29	DISASSEMBLE CAMERA TO TIGHTEN INACCESSIBLE SCREWS TO A HAND-TIGHT FIT.	
15	INSPECT FLASHGUN BATTERIES FOR CORROSION, BULGING.		30	LUBRICATE CAMERA IN ACCORDANCE WITH THE SPECIFIED DEPARTMENT OF THE ARMY LUBRICATION ORDER. PAR 29d	
			31	INSPECT CAMERA FOR PROPER MOISTURE AND FUNGUS PROOFING.	

32 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

DA FORM 11-255

REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM 2312A-23

Figure 23. DA Form 11-255.

b. Circled items in figures 22 and 23 are partially or totally applicable to Camera PH-545A/PF. References in the ITEM block refer to paragraphs in the text which contain additional maintenance information.

Section II. LUBRICATION

32. General

All parts of Camera PH-545A/PF are lubricated during manufacture. It is not necessary to lubricate the equipment prior to use. The lubrication indicated in this section is to be accomplished at quarterly intervals. If inadequate or excessive lubrication is indicated after extensive use of the equipment in the field, the lubrication procedure should be adjusted to these new requirements.

33. Lubrication After Stripping and Overhaul

Instructions for lubricating after stripping and overhauling the equipment are found in chapter 5, section III. This lubrication must not be attempted by operators or repairmen at organizational maintenance level.

34. Lubrication of Equipment

a. *Precautions.* The intervals indicated for lubrication are maximum for a normal 8-hour day operation. Intervals should be adjusted to compensate for abnormal conditions of activities.

b. *Camera Stand.* Lubricate the camera stand in accordance with figure 9. Reference letters A and B, which are keyed to the illustration, indicate the lubrication points. The method and type of lubrication are as follows: At points A, every 3 months, clean and wipe all rods, bars, steel tapes, and posts with a lint-free cloth lightly dampened with Grease, Aircraft and Instruments (GL). At points B, every 3 months, clean the camera stand with a camel's-hair brush and a lint-free cloth lightly dampened with grease (GL). Lubricate all couplings, swivels, threaded clamps, mounting screws, friction clamps, leveling screws, and adjusting clamps with 2 drops of oil (PL Special).

c. *Camera.* Lubricate the camera in accordance with the figure references listed in the chart below. Reference numbers in the figures are keyed to the chart below. The oil and grease recommended for use with this equipment are as follows: oil (PL Special) and grease (GL). For all parts, lubricate every 3 months.

c. Camera (contd).

Ref. No. and fig. No.	Lubricant	
13, fig. 25	PL	Bearing, 2 drops.
18, fig. 25	PL	Supply cover hinge, 2 drops.
20, fig. 25	PL	Take-up cover hinge, 2 drops.
26, fig. 25	PL	Hub, 2 drops.
41, fig. 25	PL	Bearing, 2 drops.
52, fig. 25	PL	Wiper, 6 drops.
48, fig. 25	PL	Tape measure. Lubricate with cloth lightly dampened with light oil.
16, fig. 26	PL	Plate bearing, 2 drops.
19, fig. 26	GL	Gear spur, light coating of grease.
33, fig. 26	GL	Gear worm, light coating of grease.
31, fig. 26	GL	Gear worm, light coating of grease.
32, fig. 26	GL	Worm, light coating of grease.
8, fig. 26	PL	Motor assembly, 5 drops.
36, fig. 26	GL	Cam, light coating of grease.
28, fig. 26	PL	Shaft bearings, 2 drops on each bearing.
15, fig. 26	PL	Drive spring, 2 drops.
23, fig. 26	PL	Hub, 2 drops.
1, fig. 31	GL	Spur gear, light coating of grease.
28, fig. 31	PL	Lever bearing, 2 drops.
20, fig. 31	PL	Wiper, 3 drops.
31, fig. 31	GL	Worm gear, light coating of grease.
24, fig. 31	PL	Plate assembly bearing, 2 drops.
15, fig. 31	PL	Bushing, 2 drops.
50, fig. 27	PL	Platen bracket assembly, 1 drop on each bearing surface.
54, fig. 27	PL	Remove plug (53) and add 3 drops in supply spindle assembly (54). Replace plug.
49, fig. 28	PL	Remove plug (50) and add 3 drops in take-up spindle assembly (49). Replace plug.
5, fig. 28	PL	Roller, 6 drops.
17, fig. 28	PL	Roller, 6 drops.
21, fig. 28	PL	Roller, 6 drops.
25, fig. 28	PL	Roller, 6 drops.
39, fig. 28	PL	Roller and plate assembly, 6 drops.
55, fig. 28	PL	Shutter hinge and linkage, 2 drops on each wear point.

Caution: To avoid overlubrication, apply lubricant with a piece of #22 AWG wire, or a similar device. After lubricating, operate the mechanism to distribute the lubricant on moving parts. Remove excess lubricant to prevent it from spreading on the rollers, platen assembly,

and film guide, and to the film on the supply spindle or the take-up spindle. See that no lubricant comes in contact with the lens assembly, or with the projection lamp.

35. Lubrication Under Unusual Conditions

Severe climatic conditions such as prevail in arctic and desert regions have some influence on the operation of the equipment. Refer to TB SIG 66, *Winter Maintenance of Signal Equipment*, and TB SIG 69, *Lubrication of Ground Signal Equipment*, for information. Proper lubrication, however, is important in the operation of the equipment in tropical climates. Humidity problems, together with fungus growth and the effect of perspiration from the hands of the operator, can be reduced by lubricants. Lubricate the equipment frequently in tropical climates so that oil in joints and bearings will be sufficient to seal out moisture, especially moisture from perspiration, which has a highly corrosive effect and a tendency to encourage fungus growth. Use a lint-free cloth to remove excessive oil or grease. Turn on the copy lamps each day for approximately 10 minutes to minimize fungus growth. The operator should dry his hands and face with a clean, dry, lint-free cloth when operating in hot humid climates as this helps to prevent perspiration from damaging the equipment.

Section III. WEATHERPROOFING

36. Weatherproofing Procedures

Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insect's, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

a. Tropical Maintenance. For tropical use, a special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained fully in TB SIG 13, *Moistureproofing and Fungiproofing Signal Corps Equipment*, and TB SIG 72, *Tropical Maintenance of Ground Signal Equipment*.

b. Winter Maintenance. For use in extremely cold and snowy climates, special precautions are necessary to prevent poor performance or total operational failure of equipment. These are explained fully in TB SIG 66.

c. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas such as deserts, which are subject to extremely high temperatures, low humidity, and excessive sand and dust, are explained fully in TB SIG 75, *Desert Maintenance of Ground Signal Equipment*.

d. Lubrication. The effects of extreme heat and cold on material and lubricants are explained fully in TB SIG 69. Observe all precautions outlined in TB SIG 69 and pay strict attention to instructions when lubricating equipment under conditions of extreme heat or cold. Refer to paragraph 34 for detailed instructions.

37. Rustproofing and Painting

Complete refinishing is a function of organizations responsible for reconditioning equipment. If small areas require refinishing, confine the work to the affected spots, but do not strip the equipment. Fungiproofing is accomplished to a limited degree at third echelon with a mobile unit. Complete fungiproofing is accomplished at fourth and fifth echelons. The refinishing of components seldom is necessary except when the equipment is reconditioned.

a. To remove old finish on the cases, camera exterior, and control panel, use paint and varnish remover. Wash off paint remover with turpentine and then with solvent (SD), before applying new finish.

b. Apply new finish with a soft-bristle paint brush or spray after masking off openings and parts not to be coated.

Caution: Do not use steel wool; minute particles frequently enter the camera case and cause harmful shorting and grounding of the circuits. Never use lye solution or any harsh cleaning agent for cleaning aluminum or wooden parts.

Section IV. TROUBLE SHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

38. General

Organizational trouble shooting is performed by the operator. Familiarity with the equipment will qualify the operator to diagnose some troubles and to make many minor repairs. Any abnormal performance must be checked, its causes discovered, and repairs made. Trouble shooting and repair work that can be performed on the equipment at the organizational maintenance level are limited in scope by the tools and test equipment available, replaceable parts issued, and the existing tactical situation. However, the equipment is of such a nature that most troubles can be found by organizational personnel through visual inspection and substitution of parts. Repairs beyond the ability of the operator must be referred to second or third echelon maintenance.

Note. The operator is responsible for preventive maintenance, and corrective measures when assembling the equipment for operational purposes. The photographic equipment repairman (MOS 1042) is responsible for organizational trouble shooting, minor repairs, or replacements of parts within a limited degree.

39. Visual Inspection

a. Check the camera for light leakage through cracks or around loose parts. Use a focusing cloth, or a darkened room, and a small light source to find light leakage. Any open screw hole that admits light will fog film and render photographs worthless. The shutter must close completely. Inspection for light leakage of the shutter may be made by holding the camera lens to the light with the film reels removed. Look through the camera and operate the shutter. No light should be visible before or after operation.

b. Failure or malfunction of the lighting equipment usually is attributed to a visible fault. When a failure occurs and the cause is not immediately apparent, check the following before starting detailed trouble shooting:

- (1) Improperly seated flood lamps.
- (2) Burned-out or broken lamps.
- (3) Improperly connected cables.
- (4) Worn, broken, or disconnected cords or connectors.
- (5) Dirty, corroded, bent, or spread contacts on connectors.
- (6) Loose or broken connections on cable connectors.
- (7) Dirty or corroded flood lamp holders.
- (8) Improperly functioning switches.

40. System Sectionalization

Refer to figures 33 and 37 and to paragraph 54 to locate and isolate the trouble in either the camera or the control panel. Repair the trouble as indicated (par. 41) or forward to higher repair service.

41. Trouble Shooting Using Equipment Performance Checklist

a. General. The equipment performance checklist (par. 42) will help to locate trouble in the equipment. The list indicates the item to be checked, the action or condition under which it is to be checked, normal indications, and corrective measures that can be taken at the operational level. To use this list effectively, follow the items in their numerical sequence.

b. Action or Condition. For some items, the information given in the *Action or condition* column consists of various switch settings under which the item is to be checked. For other items, it represents an action that must be taken to check the normal indication given in the *Normal indications* column.

c. Normal Indications. The normal indications listed include the visible signs which should be present if the equipment is operating normally. If these signs are not normal, the recommended corrective measures should be applied.

d. Corrective Measures. The corrective measures listed are those which the operator can make without turning in the equipment for repairs. If the equipment is completely inoperative, or if the recommended corrective measures do not yield results, trouble shooting at the field maintenance level is necessary. However, if the tactical situation requires that operation be maintained, and if the equipment is not completely inoperative, the operator must try to keep the equipment in operation as long as it is possible to do so.

42. Equipment Performance Checklist

Item No.	Item	Action or condition	Normal indications	Corrective measures
1	UNEXPOSED FOOTAGE indicator.	Indicator registers other than 100 when a 100 foot loaded supply reel is placed on the supply spindle.	UNEXPOSED FOOTAGE indicator registers 100	Adjust linkage by loosening nut (13) and turning shaft (12) (fig. 30)
2	EXPOSURE COUNTER.	Set at zero	Index mark opposite zero.	Turn EXPOSURE COUNTER reset knob in the direction the number wheels rotate until all the zeros are in the counter window
3	Take-up reels.	Film binds on reel flanges when camera is threaded.	Film winds onto reel without binding	Slide film spool gage between the flanges to adjust and establish the correct width. Use the 16- and 35-mm film spool gages for the 16- and 35-mm film spools, respectively.
4	Film compartment doors.	Film compartment doors will not close tightly when 35-mm film reels are installed in film compartment.	Film compartment doors close tightly.	Remove the 16-mm conversion kit, upper adapters, and spindle adapters; then close the doors.

P R E P A R A T O R Y	5	Film guide.	Film does not pass through the film guide (35-mm film). Film slips loosely through the film guide with excessive amount of clearance (16-mm film).	Film passes easily through film guide. Film passes easily through film guide with adequate clearance only.	Remove 16-mm guide assembly. Install 16-mm guide assembly.
	6	Take-up cover.	Take-up cover does not close tightly.	Take-up cover closes tightly.	See that proper combination of spools and adapters are being used.
S T A R T	7	Power source.	No ac or dc power to control panel.	Power to control panel indicated on voltmeter.	Connect control panel to 100- to 120-volt ac/dc power source, and turn the power switch to the ON position.
	8	Power source.	No ac power available; only reflector flood lamps, voltmeter, and light switch operative when light switch is turned to the EXPOSE position.	Complete camera equipment operative.	Connect control panel to 110- to 120-volt dc power source, then connect converter into the receptacle on the control panel marked CONVERTER. See that the converter is operating properly.
	9	Projection lamp.	Does not light when the power switch is at ON, and the light switch is turned to the FRAME position.	Projection lamp lights and projects light pattern on easel.	See that bulb is installed properly; replace if defective. If bulb is not defective, transformer may be defective. Check and replace transformer.

42. Equipment Performance Checklist (contd)

Item No.	Item	Action or condition	Normal indications	Corrective measures
S T A R T	10 Relay K601.	The reflector flood lamps, voltmeter, and ILLUMINATION CONTROL function properly, but rest of system is inoperative and has no power.	Power on complete system, and operation is normal. For dc power operation, relay contacts remain in normally closed position. For ac power operation, relay coil is energized to close relay contacts.	Replace defective or malfunctioning relay if additional checking warrants it.
	11 Lens.	Focus and reduction.	Image on film is in sharp focus, and image occupies the maximum amount available space on negative.	Rotate lens to the reduction determined by the size of the copy being photographed. Position the camera on the stand to this reduction factor.
P E R F O R M A N C E	12 Film advance.	Subsequent photographs overlap on negatives.	Film advances a full frame when foot switch is actuated. The film advance control mechanism is correlated with the aperture to accommodate a document, and automatically stops the film advance when enough film has been moved forward to photograph that document.	Adjust film advance mechanism.

13	ILLUMINATION CONTROL.	With power switch at ON, manipulate the ILLUMINATION CONTROL fully in both directions while observing the reflector flood lamps and the voltmeter.	As the voltmeter reading varies from one extreme to the other, the intensity of illumination of the reflector flood lamps also varies.	No corrective measure necessary. This is a normal indication. If manipulation of ILLUMINATION CONTROL has no effect on the voltage or light intensity, it indicates a malfunctioning or defective potentiometer. Replace if necessary.
14	Reflector flood lamps (300 watts).	Lamps do not light.	Bulbs light when power switch is in the ON position, and the light switch is turned to the EXPOSE position.	Replace defective bulbs.
15	APERTURE AND FILM FEED CONTROL.	Manipulate the APERTURE AND FILM FEED CONTROL from one extreme to the other and note the light pattern on the easel.	Size of light pattern on easel changes to correspond with the manipulation of the control. Light switch turned to FRAME position, and power switch to ON.	No corrective measure necessary. This is a normal indication.
16	Foot switch.	Power switch at ON, light switch on EXPOSE. Reflector flood lamps light. Either ac or dc power may be supplied. Relay K601 functioning properly. All external connections are made properly. Foot switch is actuated, but no cycle of operation takes place as in normal operation.	Camera motor begins to operate, shutter exposes film correctly, and closes. Film advances and motor shuts off at completion of single revolution.	Replace defective foot switch, if subsequent tests verify that it is defective. Relay K602 may be defective. Coil is not energized to close contacts on relay. If defective, replace. Also determine if transformer is defective. If it is, replace it.

42. Equipment Performance Checklist (contd)

Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	17 Alarm buzzer and micro-switch.	No alarm indication when normal preparation has been completed, all required switches are set, all connections made, and either the supply spool or the take-up spool, or both, are removed from the camera. No alarm sounds when the film does not feed properly, or when the film is broken.	Alarm sounds when either the supply or the take-up spool is removed from the camera, when the film does not feed properly, when the film breaks, and when the film supply is exhausted.	Replace defective alarm buzzer. Replace defective microswitch or adjust it and its connecting linkage. Replace defective transformer.
	18 Transformer.	Transformer winding defective. Camera motor, alarm buzzer, foot switch, projection lamp, and relay K602 inoperative. Transformer secondary inoperative. Foot switch, projection lamp, alarm buzzer, and relay K602 inoperative.	The units listed are operative. Check secondary to read 6 to 8 volts. Foot switch, projection lamp, alarm buzzer, and relay K602 operative.	Relay K601 defective. Converter not supplying ac power through control panel. Transformer defective. Replace relay or transformer. Replace defective transformer.

CHAPTER 4

THEORY OF OPERATION

43. Use of Converter

Camera PH-545A/PF will operate on ac only, but a power converter used as auxiliary equipment will permit the equipment to operate also on dc. The converter which is connected into the control panel CONVERTER receptacle must be of the 150-watt vibrator or rotary type and have a 150-watt minimum 115-volt ac, 60-cycle output. A rotary-type converter is preferred for extended operation.

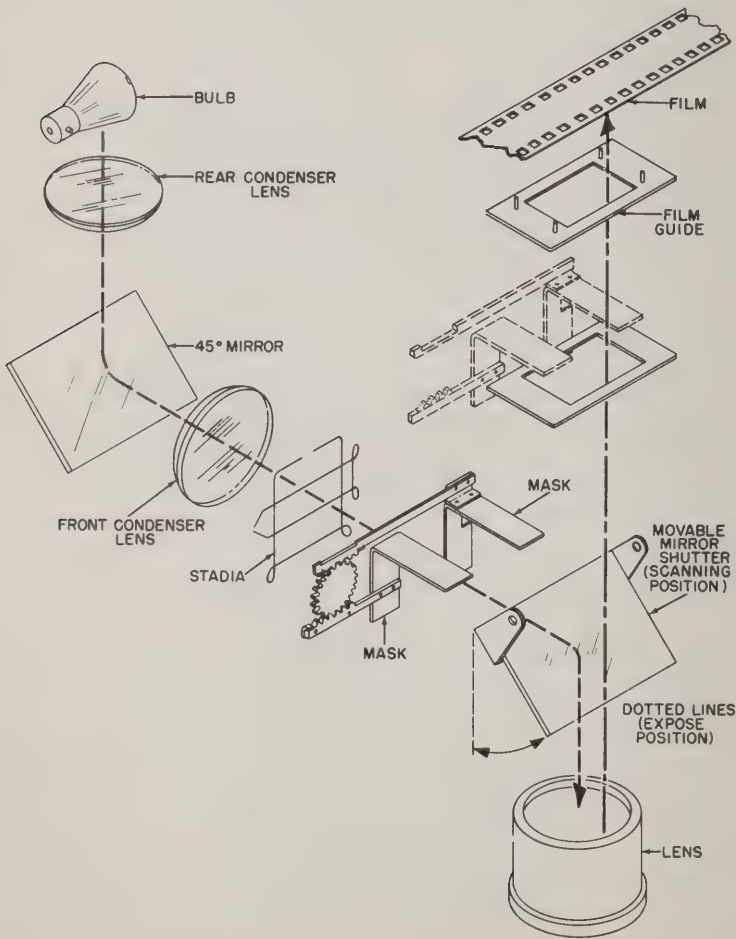
44. General Theory

The following paragraphs contain a detailed discussion, divided into four parts, of the theory of operation of Camera PH-545A/PF. The discussion consists of the optical system theory of operation, the electrical system theory of operation, the mechanical theory of operation, and the operation cycle.

45. Optical System Theory of Operation (fig. 24)

a. General. The optical system of the camera is designed so that the camera is used not only for photographing the documents on microfilm, but also as a scanning device so that the operator may view and, at the same time, control the size of the exact area to be photographed prior to exposing the film. Manual adjustments enable the operator to correlate camera focus, image framing, and film transport so that the size of the image on the film will be at its maximum size commensurate with the dimensions of the film being used. The film transport mechanism and framing device are synchronized so that the amount of film which is advanced will be in correct proportion to the size of the document to be microfilmed. It insures that subsequent images on the film do not overlap or that an excessive amount of space is not left between subsequent images unless it is desired.

b. Reduction Factor. The relationship between the size of the copy to be microfilmed and the size of the image of the copy on the film will vary with the distance of the camera from the copy. The reduction factor is a number which is derived from mathematical calculations based on the length and width of the copy and the usable area of 16- or 35-mm film. A chart has been compiled from these calculations (par. 20b(2)) which lists all of the possible reduction factors and their corresponding field sizes. After determining from the chart the required reduction factor, the camera is positioned so



TM 2312A-24

Figure 24. Optical system, exploded view.

that it is in alinement with the reduction factor on the calibrated rod of the stand assembly. Then the reduction factor calibration on the lens barrel also is set to correspond with this number. These adjustments assure the operator that the lens will be in sharp focus and that the complete image will be properly centered on the microfilm.

c. Projecting and Centering. A scanning device is provided whereby the camera projects a rectangle of light through the camera lens to the easel to indicate the exact field of view. Figure 24 illustrates this operation. The light which passes from the projection lamp through the rear condenser lens is reflected by a mirror at a fixed 45° angle, through a front condenser lens, a stadia assembly, and a mask assembly, and then is reflected by a movable mirror through the lens to the easel. The stadia, an outline of piano wire (fig. 32), forms a rectangle which is projected onto the easel to provide a means of centering the copy so that it will be in proper alinement when it is microfilmed. Although the projected light pattern indicates the exact field of view of the camera, the **APERTURE AND FILM FEED CONTROL** (which is mechanically linked to the masks) functions as a variable longitudinal mask control to the light pattern. In use, the control is turned until the masks limit the light pattern longitudinally so that it just covers the copy on the easel. An extension of the mask assembly functions simultaneously and in the same manner to provide a mask during exposure of the film. To expose the film after the scanning and centering operations are completed, the mirror-shutter is moved back to the dotted position to allow the light from the copy to pass through the lens and the masks to the film.

d. Film Image Limits (fig. 17). When the masks are extended to their widest limits, the maximum size of the image on the film is governed by the size of the opening in the 16-mm film guide adapter when 16-mm film is being used, and by the dimensions of the opening in the top plate when 35-mm film is used. The maximum dimensions for the 16-mm film are 9/32 inch (0.594) wide and 1-1/4 inch (1.250) long; for 35-mm film, 1-1/4 inch (1.250) wide and 1-1/2 inch (1.50) long. The masks, controlled by the **APERTURE AND FILM FEED CONTROL**, have no effect on the width of the image, but do control the length of the image from its maximum length to the desired masked size.

46. Electrical System Theory of Operation

a. Power Supply. The electrical system is designed to operate from a 110- to 120-volt, 60-cycle ac power source, but an accessory converter may be attached to operate the equipment from a 110- to 120-volt dc power source. The reflector flood lamps, voltmeter, and **ILLUMINATION CONTROL** function on either alternating or direct current.

b. Interconnections (fig. 15). The camera, lighting equipment, converter, and foot switch are connected by cable connections to the control panel, which is the central unit in the electrical system. The control panel is connected by a cable and plug to a 110- to 120-volt ac or dc power source. When dc is the main source of power to the control panel, a converter is connected into the **CONVERTER** receptacle on the control panel to provide the ac necessary for system operation. The photoflood lamp circuit is connected to the **LAMPS** receptacle, and the foot switch and attaching cable are connected to the **FOOT SWITCH** receptacle on the control panel. Power to the camera is provided by connecting one end of the control cable to the **CAMERA** receptacle on the control panel, and the other end to the receptacle on the camera.

c. Theory of Operation (figs. 33 and 37). The two 300-watt, 90-volt reflector flood lamps, which are wired in parallel, and the 0 to 130-volt ac/dc voltmeter are connected in series with a 15-ohm, 500-watt variable resistor **ILLUMINATION CONTROL**. The voltage and the light intensity of the reflector flood lamps both are controlled by manipulating the **ILLUMINATION CONTROL**. These units function when the two-position light switch is in the **EXPOSE** position, and the power switch is at **ON**. In the **FRAME** position, the secondary of the step-down transformer provides 6 to 8 volts to illuminate the projection lamp. In the **EXPOSE** position, the secondary of the transformer also provides 6 to 8 volts ac to energize the coil in relay **K602** to close its contacts, to operate the alarm buzzer when the microswitch is actuated and to actuate the single revolution actuator after the foot switch is actuated. The foot switch is connected so that when it is actuated, the normally open switch on the single revolution actuator is closed. The actuator then operates to complete its single revolution after which a cam again opens the switch to stop the actuator. The foot switch must be actuated to begin a second series of operations. Direct current will not energize relay **K601** and, as illustrated, the contacts remain in their normally closed position. Current flow is across contacts 1 and 3 of relay **K601** through pins 13 and 14 to the converter. Alternating current from the converter is across pins 15 and 16 to contact 5 on the **K601**, then to the transformer primary and through pin 10 and pin 8 on the **CAMERA** receptacle to the single revolution actuator. None of these circuits is operative until the foot switch is actuated; the foot switch is closed and the normally open switch on the single revolution actuator is closed simultaneously. Current is induced in the transformer secondary to energize the coil of relay **K602** to close contacts and complete the circuit through **CAMERA** receptacle pins 7 and 11. When the single revolution actuator is actuated by the foot switch, it completes one revolution of operation, then a cam opens the switch to interrupt the circuit and stop the actuator. The foot switch again must be actuated

to initiate this sequence once more. In the **EXPOSE** position, the secondary of the step-down transformer provides 6 to 8 volts ac to energize K602, the projection lamp, foot switch, microswitch, alarm buzzer, and one side of the light switch. The microswitch and alarm buzzer are arranged mechanically so that when the film on the supply spool is exhausted, is not feeding properly, or breaks, the microswitch is actuated to sound the alarm buzzer. When the light switch is in the **FRAME** position, current from the transformer secondary illuminates the projection lamp. When the power source connected to the control panel is from 110 to 120 volts ac, the system functions the same, but relay K601 is energized and contacts 2, 4, and 6 are closed. Fixed resistor R1 and capacitor C1 in the line to the coil of relay K601 aid in the rate at which the coil is de-energized. The various cords terminate in plugs which are designed to make it impossible to insert a plug into the wrong receptacle.

47. Mechanical Theory of Operation

a. *General.* Camera PH-545A/PF is designed as a lightweight, portable, microfilming equipment provided with two mountings (figs. 13 and 14). One mounting supports the camera housing so that the optical axis of the lens is vertical for photographing documents placed on the easel beneath it. The other mounting supports the housing so that the optical axis of the lens is horizontal to provide for photographing documents which are large enough to be attached to a wall.

b. *Framing.* Incorporated in the camera and adjusted by an external control is a mask assembly which provides variable longitudinal film masking. This mask is related to the size of the image which will appear on the film (par. 45).

c. *Film Transport Mechanism.* A rubber covered transport roller which is coupled mechanically to the single revolution actuator, provides the means to draw the unexposed film across the opening in the plate assembly, then hesitates a moment while the platen is lowered to depress the film evenly and smoothly against the platen plate. The movable shutter opens for a predetermined length of time, the platen is raised, and the transport roller moves the exposed film across the opening toward the take-up spool. This cycle of operation is begun by actuating a foot switch. A single revolution actuator provides the means and the mechanical power. If the size of the documents is uniform, and the required degree of reduction is the same, the size of the image and the amount of film exposed for each image will be the same. This, however, is not a typical operation. Usually, documents are presented in various sizes and necessitate a variety of different reduction factors. The amount of space that each image will require on the microfilm will vary with the original size of the document and the amount of

reduction necessary. To prevent one image from overlapping the previous exposure, or the subsequent exposure, a mechanical design feature provides that a greater amount of film is advanced during film transport when the image reduction is small, and a lesser amount if the image reduction is great. During the scanning operation, the light pattern indicates the exact field of view of the camera, and the mask assembly is adjusted to mask the copy longitudinally. The **APERTURE AND FILM FEED CONTROL** on the camera controls both of these adjustments. An **EXPOSURE COUNTER** is connected mechanically to indicate the number of exposures. An **UNEXPOSED FOOTAGE** indicator, which is connected to an arm assembly that rides on the film supply reel, provides a rough indication of the amount of unexposed film remaining on the reel. The 20-foot calibration increments are based on the diameter of the film remaining on the supply spool. A full spool indicates 100; an empty spool 0.

48. Operational Cycle (fig. 1)

a. General. When the camera is loaded and adjusted to the correct reduction factor, the copy positioned correctly on the easel or wall, and all of the necessary connections to the power source and control panel are made, the microfilming operation can begin.

b. Scanning. Move the light switch to the **FRAME** position, and the power switch to **ON**. The projection lamp on the camera will project a beam of light to the copy on the easel. After the **APERTURE AND FILM FEED CONTROL** is adjusted to mask the copy properly, turn the light switch to the **EXPOSE** position. The projection light goes off.

c. Microfilming. The **ILLUMINATION CONTROL** is adjusted until the light intensity is at the recommended value as indicated by the light meter positioned over the copy. Actuate the foot switch. The following sequence cannot be seen but the various events which take place are audible: the platen arm will lower the platen over the film and hold it against the platen plate through which the exposure will come; the movable shutter will open then close after a fixed time interval; the platen and the platen arm will rise, the single revolution actuator will be heard actuating the film transport mechanism which moves the exposed film toward the take-up reel. When this operation is completed, the camera again is quiet. If another copy of the document is desired, it is only necessary to actuate the foot switch. If other copy is to be microfilmed, the complete cycle of events must be repeated. Turn the power switch to the **OFF** position.

Note. The camera operator normally will collate documents of the same size and of the same reduction ratio to keep major adjustments of the camera to a minimum and speed up the microfilming operation.

CHAPTER 5

FIELD MAINTENANCE INSTRUCTIONS

Note. This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenance responsibilities is limited only by the tools and test equipment available, and by the skill of the repairman.

Section I. INSPECTING, STRIPPING, AND CLEANING

49. Inspecting

a. General Procedure. Examine the equipment for dents, holes, corrosion, fungus, loose or missing screws, and hardware and painted surfaces which are bare or badly scratched. Check receptacles for cracked bodies; dirty, corroded, bent, or spread contacts; and loose mountings. Check switches for freedom of movement, positive action, and security of mountings. Examine the lamps for firm seating in their sockets. Inspect the cable assemblies for wear and cuts in insulation and for faulty connectors. Apply power to the equipment and check to see that lamps light when the associated switch is turned on. With the exception of the camera, the equipment is simple and subject to little wearing friction. Consequently, failure is infrequent except for breakage. Breakage and stripped threads are readily discernible. Inspect the camera very closely to detect wear that exceeds workable tolerances, bent and misaligned parts, and conditions that may reduce efficiency of the equipment. Growth of fungus or an accumulation of moisture on the equipment is an indication of ineffective fungiproofing.

b. Tools. Use tool equipment TK-24/GF (General tools for repair of photographic equipment), which contains all the tools necessary for the maintenance of this equipment.

50. Stripping

If the equipment is to be moved to another location, or prepared for shipment or storage, disassemble the different components by reversing the assembly procedure outlined in paragraph 14. Removal, disassembly, and reassembly of the components which make up the equipment are described in paragraphs 55 through 58. Complete disassembly and repair are the responsibility of a skilled repairman.

51. Cleaning

Clean all disassembled parts by immersing them in, or brushing them with, solvent (SD), with the exception of the lens and lens mount assembly. Do not use solvent on the lens or lens mount, because it softens the lens coating so that it may be easily damaged or removed. Dust the lens carefully with a camel's-hair brush; blow off the remaining dust with an air syringe, and gently clean the lens with a drop of liquid lens cleaner on a lens tissue. Use a dry piece of lens tissue to wipe the lens dry. Dust the interior of the camera by brushing it with a camel's-hair brush; then blow out the remaining dust with an air syringe.

Section II. TROUBLE SHOOTING AT FIELD MAINTENANCE LEVEL

52. Trouble-shooting Procedure

The first step in servicing defective equipment is to sectionalize the fault. This means tracing the fault to the major component, circuit, or assembly. The second step is to localize the trouble by tracing the fault to the defective part. Refer to figures 33, 36, and 37 as an aid in sectionalizing as well as localizing troubles. To replace a malfunctioning or defective unit or component, refer to paragraphs 55 through 58.

53. Trouble-shooting Technique

Troubles rarely are encountered with Camera PH-545A/PF, unless it has been subjected to rough handling or unusual conditions during operation. Eventually, however, normal wear may cause trouble or necessitate the replacement of worn parts. The following subparagraphs (a, b, and c below) will serve as a guide and offer a procedure for locating trouble.

a. Electrical Troubles (figs. 33, 36, and 37).

- (1) *General.* Continuity test equipment is useful in tracing electrical circuits. Reference to the wiring diagrams will be helpful whenever electrical troubles are encountered.
- (2) *Lighting equipment.* With the exception of broken or missing items, such as bulbs, which may be detected readily, lighting equipment failure can be due only to burned out lamps or bulbs, short or open circuits, or an improper power source.

- (3) *Connecting cords.* Whenever electrical failure occurs in the entire equipment, the electrical cords should be inspected for breaks, bad connections, or short circuits. When electrical trouble occurs in the camera, the interconnecting cord should be tested, and the defective circuit traced from the power control unit to the questionable parts of the camera. If the trouble lies in a defective connection or a broken connecting wire, repairs may be made by soldering the connection or replacing the wire. If the trouble lies in a defective part, such as a transformer, relay, or motor, the part must be replaced.

b. Optical Troubles (fig. 24). The optical system admits light from the document on the easel to expose the film, and projects light from the projection lamp to the easel for scanning purposes. Troubles occurring in the finder system are confined to the projection lamp, the condensers, the fixed reflecting mirror, the mask assembly, the mirror-shutter, and the camera lens. Troubles in the exposure system are confined to the camera, camera lens, mask assembly, or the mirror-shutter. Little difficulty should be encountered in isolating optical troubles. Correction usually will require replacement of the defective parts. Refer to the appropriate exploded views of the camera.

Caution: Critical setting of the camera lens is absolutely essential for proper operation. Under no condition should the camera lens be removed for repairs in the field.

c. Mechanical Troubles. Mechanical troubles may be remedied either by repairing or replacing the defective part. Troubles occurring in the camera stand will be obvious to the maintenance man and should be easily corrected. The correction of mechanical troubles which may occur inside the camera, particularly within the mechanism compartment, requires a thorough understanding of the theory of operation, and of the exploded views, figures 25 through 31. By opening the camera compartment and loading the camera with film, the maintenance personnel can observe the camera in operation. If the functions of the various parts are understood, it is not difficult to locate the trouble and replace any defective parts, or make the necessary adjustments outlined in paragraph 61.

54. Trouble-shooting Chart

The trouble-shooting chart which follows will help to locate troubles quickly.

a. *Electrical System* (figs. 33 and 37).

Symptom	Probable trouble	Correction
Equipment fails to operate, (ac or dc operation).	Defective power source. Defective power cord. Defective main switch.	Check power source. Repair or replace cord. Replace main switch.
Camera fails to operate, but reflector flood lamps light (dc operation).	Converter not connected. Shorted blocking capacitor. Defective converter. Defective wiring.	Connect converter. Replace capacitor. Replace converter. Trace wiring and replace as necessary.
Camera fails to operate, but reflector flood lamps light (ac operation).	Open blocking capacitor. Defective general purpose relay.	Replace capacitor. Replace relay.
Camera operates but reflector flood lamps do not light (ac or dc operation).	Defective lamps. Defective rheostat. Defective light switch. Defective wiring.	Replace lamps. Replace rheostat. Replace light switch. Trace wiring, and repair as necessary.
Projection (finder) lamp does not light.	Defective lamp. Defective light switch. Defective adjustable resistor. Defective projection lamp transformer. Defective connections in plugs or receptacles. Defective wiring.	Replace lamp. Replace light switch. Replace adjustable resistor. Replace transformer. Repair or replace plugs or receptacles. Trace wiring, and repair as necessary.

Camera fails to operate when foot switch is actuated.	Defective foot switch. Defective projection lamp transformer. Defective connections in plugs or receptacles. Defective motor control relay. Defective camera drive motor. Defective wiring.	Replace foot switch. Replace transformer. Repair or replace plugs or receptacles. Replace motor control relay. Replace motor. Trace wiring, and repair as necessary.
Alarm buzzer does not sound.	Defective buzzer. Defective buzzer transformer. Defective wiring in alarm system. Defective alarm contacts.	Replace buzzer. Replace transformer. Trace wiring, and repair as necessary. Clean alarm contacts.

b. Optical and Mechanical System.

Symptom	Probable trouble	Correction
Alarm buzzer sound (camera loaded with film).	Film not fastened to take-up spool. Bent take-up spool. Film broken.	Fasten film to take-up spool. Straighten or replace spool. Remove exposed film and install empty take-up spool. Rephotograph documents as required.
Images not sharply focused. (Noted from processed film, retake required.)	Camera lens dirty. Camera moved. Wrong lens settings.	Clean camera lens. Be sure camera equipment is assembled securely and mounted rigidly. Set lens to proper settings.

b. Optical and Mechanical System (contd)

Symptom	Probable trouble	Correction
Documents not completely covered. (Noted from processed film, retake necessary.)	Improper aperture adjustment.	Reset aperture with light switch set to FRAME.
	Film slipping on film drive roller.	Clean surface of roller.
	Hold-back pawl worn or spring broken.	Replace defective part.
	Film advance pawl worn or spring worn.	Replace defective part.
	Film drive ratchet wheel worn.	Replace.
Images overlap at regular intervals.	Film advance cam improperly adjusted.	Adjust film advance cam.
Too much space between images.	Film advance cam improperly adjusted, or locking screws loose.	Adjust film advance cam and tighten screws.
Images overlap on first exposure after aperture is widened.	Auxiliary film advance pawl defective.	Replace auxiliary pawl.
Images on film spaced too far apart.	Film advance cam improperly adjusted, or set screws loose.	Remove film drive wheel. Readjust and tighten set screws.
Projection lamp does not project beam of light on easel.	Mirror-shutter remains open.	Mirror-shutter spring broken, or mirror-shutter jammed in open position.
	Light beam reflecting mirror broken.	Replace light beam reflecting mirror.
Images too light or too dark. (Noted from processed film, retakes required.)	Light meter out of adjustment, or calibration faulty.	Recalibrate light meter.

Section III. REPAIRS

55. General Repair Instructions

Replaceable parts of the camera equipment that can be removed with ordinary tools, or with photographic equipment repairman's tools, are shown in exploded views. Removal of the camera for organizational maintenance or replacement, replacement of the film reels, replacement of the bulb, and interchanging or replacing the 35-mm and the 16-mm adapter kits may be accomplished by the operator. Disassembly and repair are the responsibility of a skilled photographic equipment repairman. Because of equipment design and the infrequent possibility of excessive wear or failure, certain parts are permanently assembled. These parts are not shown exploded. Do not attempt to disassemble or repair such parts as they are replaced as assemblies.

56. Camera Field Maintenance

a. Disassembly of Camera.

(1) *Disassembly of camera housing assembly* (fig. 25). Proceed as follows to disassemble the camera housing assembly.

- (a) Remove the upper adapters (1 and 2), used for 16-mm film reel operation, by unscrewing them in a counterclockwise direction.
- (b) Slip the 16-mm supply reel (3) and the 16-mm spindle adapter (4) off the supply spindle.
- (c) Slip the 16-mm take-up reel (5) and 16-mm spindle adapter (6) off the take-up spindle.

Note. If the camera was operating with 35-mm film, remove the 35-mm supply reel and the 35-mm take-up reel (7, fig. 25). Disregard steps (b) and (c) above.

- (d) Remove the plug (8) by removing the two screws (9).
- (e) Remove the knob (10) by removing the retaining ring (11) and two washers (12). Remove the bearing (13) and the two washers (14).
- (f) Remove the nameplate (15) by removing the four screws (16) and lock washers (17).
- (g) Remove the supply cover (18) from the housing assembly (66) by removing the seven screws (19).
- (h) Remove the take-up cover (20) by removing the three screws (21).

- (i) Remove the wheel (22) by removing the groove-pin (23). Slip the wheel (24) and spring (25) from the cover. Remove the hub (26) by removing the two screws (27) and lock washers (28). Remove the stud (29) and handle (30) by removing the screw (31) and lock washers (32).
- (j) Remove the nameplate (33) by removing the four screws (34) and lock washers (35). Remove the plug (36) by removing the two screws (37).
- (k) Remove the knob (38) by removing the retaining ring (39) and two washers (40), then remove the bearing (41) and two washers (42).

LEGEND FOR FIGURE 25

- | | |
|---|---|
| 1. Upper adapter. | 34. Screw. |
| 2. Upper adapter. | 35. Lock washer. |
| 3. 16-mm supply reel. | 36. Plug. |
| 4. 16-mm spindle adapter. | 37. Screw. |
| 5. 16-mm take-up reel. | 38. Knob. |
| 6. 16-mm spindle adapter. | 39. Retaining ring. |
| 7. 35-mm reel. | 40. Washer. |
| 8. Plug. | 41. Bearing. |
| 9. Screw. | 42. Washer. |
| 10. Knob. | 43. Cover. |
| 11. Retaining ring. | 44. Captive screw. |
| 12. Washer. | 45. Captive washer. |
| 13. Bearing. | 46. Label assembly. |
| 14. Washer. | 47. Screw. |
| 15. Name plate. | 48. Tape measure. |
| 16. Screw. | 49. Bracket. |
| 17. Lock washer. | 50. Screw. |
| 18. Supply cover. | 51. Wiper bracket. |
| 19. Screw. | 52. Wiper. |
| 20. Take-up cover. | 53. Screw. |
| 21. Screw. | 54. Name plate
(UNEXPOSED FOOTAGE). |
| 22. Wheel (sprocket). | 55. Screw. |
| 23. Groove-pin. | 56. Lock washer. |
| 24. Hand wheel. | 57. Name plate
(EXPOSURE COUNTER). |
| 25. Spring. | 58. Screw. |
| 26. Hub. | 59. Lock washer. |
| 27. Screw. | 60. Screw. |
| 28. Lock washer. | 61. Lock washer. |
| 29. Stud. | 62. Name plate (APERTURE AND
FILM FEED CONTROL). |
| 30. Handle. | 63. Plate. |
| 31. Screw. | 64. Screw. |
| 32. Lock washer. | 65. Lock washer. |
| 33. Name plate (WARNING AFTER
LOADING AND BEFORE
UNLOADING CAMERA TURN
CRANK 8 TURNS). | 66. Housing assembly. |

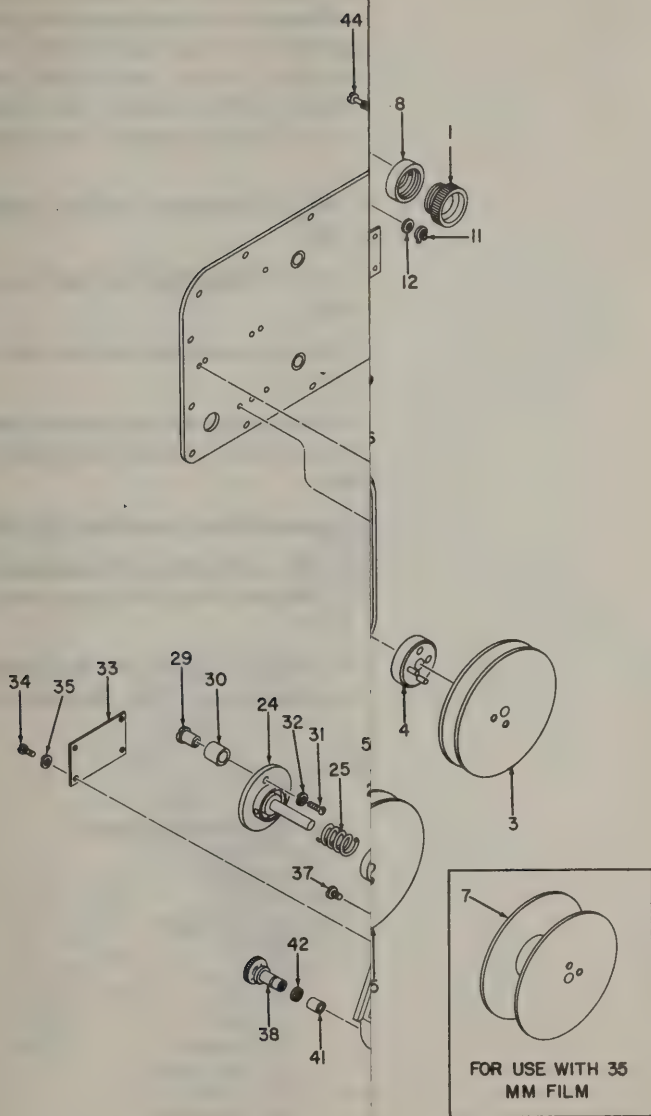


Figure 26. Mechanism compartment assemblies.

TM 2312A-25

- (i) Remove the wheel (22) by removing the groove-pin (23). Slip the wheel (24) and spring (25) from the cover. Remove the hub (26) by removing the two screws (27) and lock washers (28). Remove the stud (29) and handle (30) by removing the screw (31) and lock washers (32).
- (j) Remove the nameplate (33) by removing the four screws (34) and lock washers (35). Remove the plug (36) by removing the two screws (37).
- (k) Remove the knob (38) by removing the retaining ring (39) and two washers (40), then remove the bearing (41) and two washers (42).

LEGEND FOR FIGURE 25

- | | |
|-------------------------------|------------------------------|
| 1. Upper adapter. | 34. Screw. |
| 2. Upper adapter. | 35. Lock washer. |
| 3. 16-mm supply reel. | 36. Plug. |
| 4. 16-mm spindle adapter. | 37. Screw. |
| 5. 16-mm take-up reel. | 38. Knob. |
| 6. 16-mm spindle adapter. | 39. Retaining ring. |
| 7. 35-mm reel. | 40. Washer. |
| 8. Plug. | 41. Bearing. |
| 9. Screw. | 42. Washer. |
| 10. Knob. | 43. Cover. |
| 11. Retaining ring. | 44. Captive screw. |
| 12. Washer. | 45. Captive washer. |
| 13. Bearing. | 46. Label assembly. |
| 14. Washer. | 47. Screw. |
| 15. Name plate. | 48. Tape measure. |
| 16. Screw. | 49. Bracket. |
| 17. Lock washer. | 50. Screw. |
| 18. Supply cover. | 51. Wiper bracket. |
| 19. Screw. | 52. Wiper. |
| 20. Take-up cover. | 53. Screw. |
| 21. Screw. | 54. Name plate |
| 22. Wheel (sprocket). | (UNEXPOSED FOOTAGE). |
| 23. Groove-pin. | 55. Screw. |
| 24. Hand wheel. | 56. Lock washer. |
| 25. Spring. | 57. Name plate |
| 26. Hub. | (EXPOSURE COUNTER). |
| 27. Screw. | 58. Screw. |
| 28. Lock washer. | 59. Lock washer. |
| 29. Stud. | 60. Screw. |
| 30. Handle. | 61. Lock washer. |
| 31. Screw. | 62. Name plate (APERTURE AND |
| 32. Lock washer. | FILM FEED CONTROL). |
| 33. Name plate (WARNING AFTER | 63. Plate. |
| LOADING AND BEFORE | 64. Screw. |
| UNLOADING CAMERA TURN | 65. Lock washer. |
| CRANK 8 TURNS). | 66. Housing assembly. |

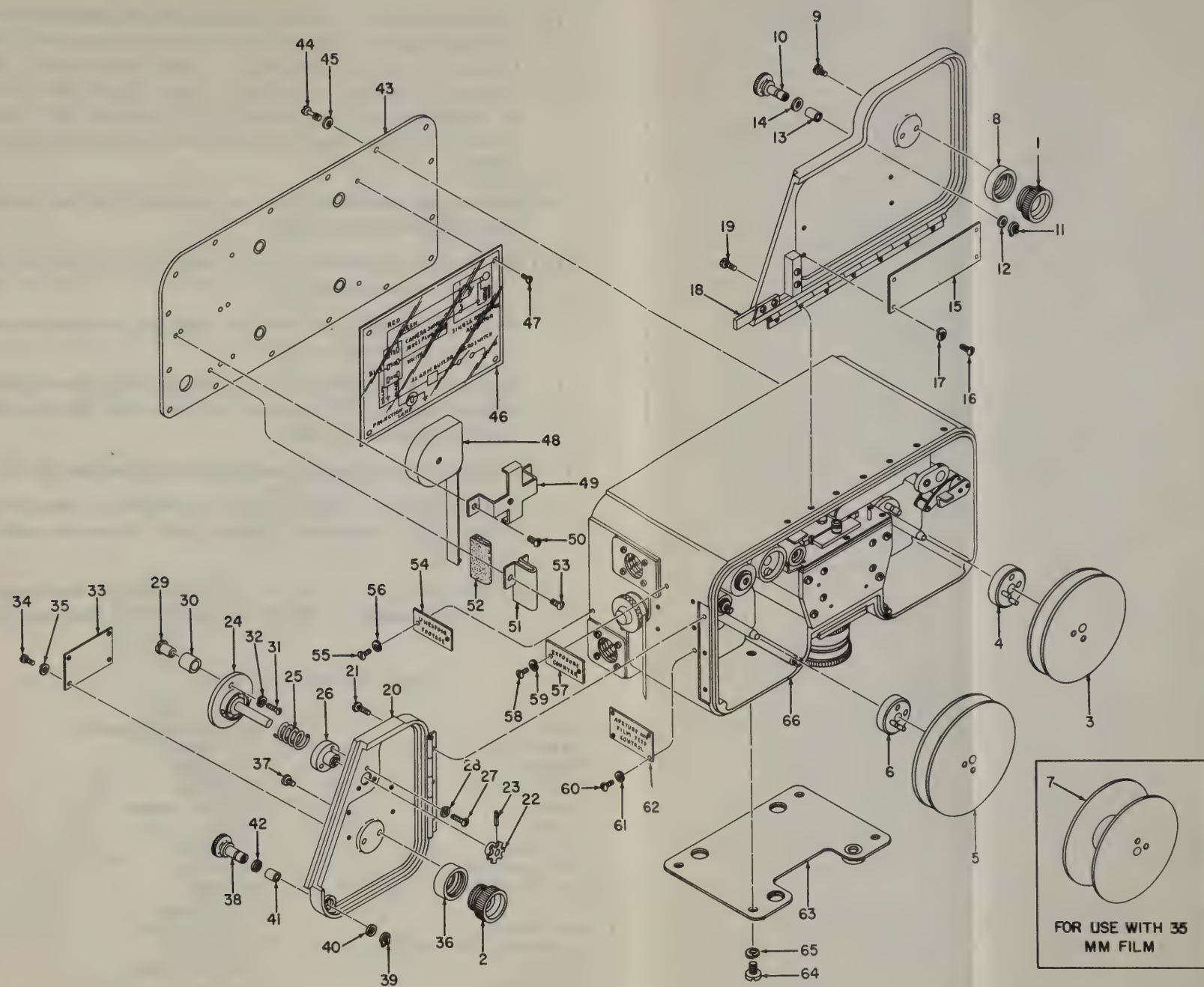
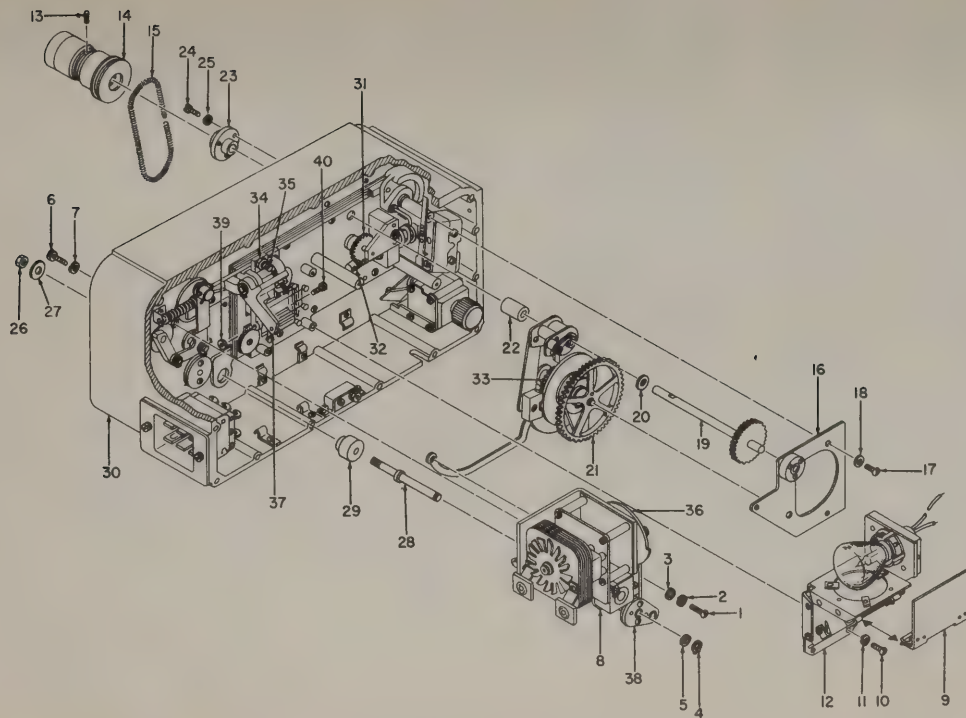


Figure 25. Camera housing assembly.

- (l) Remove the cover (43) by removing the 16 captive screws (44) and washers (45). Remove the label assembly (46) from the cover by removing the four screws (47). To remove the tape measure (48), remove the bracket (49) by removing the two screws (50). Remove the wiper bracket (51) and wiper (52) by removing the two screws (53).
- (m) Remove the nameplate (54) by removing the four screws (55) and lock washers (56).
- (n) Remove the nameplate (57) by removing the four screws (58) and lock washers (59).
- (o) Remove the nameplate (62) by removing the four screws (60) and lock washers (61).
- (p) Remove the plate (63) by removing the four screws (64) and lockwashers (65) that are used to attach the plate to the housing assembly (66).
- (2) *Disassembly of mechanism compartment assemblies (fig. 26).*
 - (a) Remove the single screw (1), lock washer (2), and plain washer (3) to disconnect the arm from the motor assembly (8).
 - (b) Remove the retaining ring (4) and washer (5) that secure the motor assembly (8) to the shaft (28). Remove the

LEGEND FOR FIGURE 26

- | | |
|--|----------------------------------|
| 1. Screw. | 21. Feed cam assembly. |
| 2. Lock washer. | 22. Spacer. |
| 3. Washer. | 23. Hub. |
| 4. Retaining ring. | 24. Screw. |
| 5. Washer. | 25. Lock washer. |
| 6. Screw. | 26. Nut. |
| 7. Lock washer. | 27. Washer. |
| 8. Motor assembly. | 28. Shaft. |
| 9. Shield assembly. | 29. Hub. |
| 10. Screw. | 30. Housing. |
| 11. Lock washer. | 31. Worm gear. |
| 12. Condensing system and lamp assembly. | 32. Worm. |
| 13. Set screw | 33. Worm gear. |
| 14. Drive roller. | 34. Nut. |
| 15. Drive spring. | 35. Screw. |
| 16. Plate. | 36. Cam. |
| 17. Screw. | 37. Lever assembly. |
| 18. Lock washer. | 38. Feed drive linkage assembly. |
| 19. Drive shaft and gear spur assembly. | 39. Nut. |
| 20. Washer. | 40. Screw. |



TM 2312A-26

Figure 26. Mechanism compartment assemblies.

four screws (6) and lock washers (7); then remove the motor assembly (8) from the housing. To replace the motor assembly, first tag the necessary wires for easy identification and reassembly; then unsolder them. (Refer also to figures 33, 36, and 37).

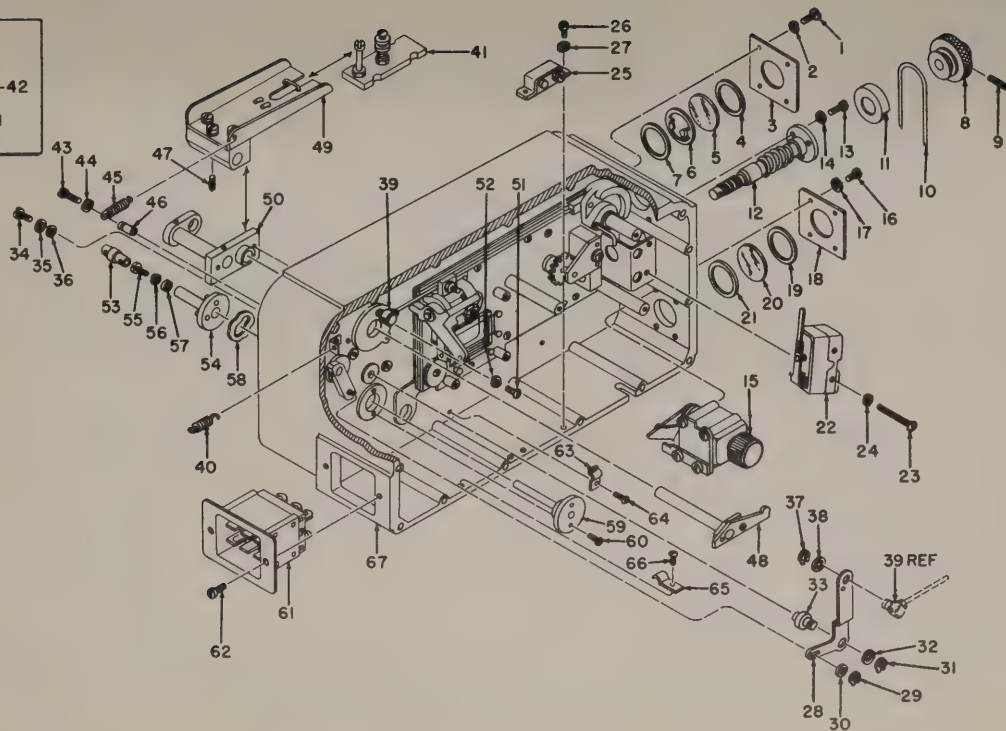
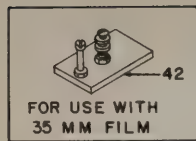
- (c) Remove the shield assembly (9). A slight pull will suffice. Remove the four screws (10) and lock washers (11); then remove the condensing system and lamp assembly (12). Tag the wires for easy identification and reassembly; then unsolder them.
 - (d) Remove the set screw (13); then slip the drive roller (14) off the drive shaft and spur gear assembly (19). Remove the drive spring (15). Do not stretch or elongate the drive spring more than necessary.
 - (e) To remove the plate (16), remove the four screws (17) and lock washers (18). Remove the drive shaft and spur gear assembly (19), washer (20), and spacer (22) from the housing and the feed drive assembly (21). Remove the feed drive assembly (21). See figure 31 for disassembly of feed cam assembly. To remove the hub (23), remove the three screws (24) and lock washers (25).
 - (f) Remove the nut (26) and washer (27); then slip out the shaft (28) and hub (29) from the housing (30).
 - (g) Remove the nut (39) and screw (40) to disconnect the actuating arm of the shutter (55, figure 28).
- (3) *Disassembly of camera primary assemblies* (fig. 27).
- (a) Remove the four screws (1) and lock washers (2) to remove the bezel (3). Remove the gasket (4), window (5), mask (6), and gasket (7).
 - (b) Remove the knob (8) by removing the set screw (9). Remove the cord (10) and guard (11). To remove the shaft assembly (12), remove the three screws (13) and lock washers (14).
 - (c) To remove the counter assembly (15), remove the four screws (16) and lock washers (17), then remove the bezel (18), gasket (19), window (20), and gasket (21).
 - (d) To remove the switch (22), remove the two screws (23) and lock washers (24).

- (e) To remove the buzzer (25), remove the two screws (26) and lock washers (27). Disconnect the necessary wires after tagging them as an aid in identification and reassembly.
- (f) To remove the lever (28), first remove the retaining ring (29), and washer (30), then remove the retaining ring (31) and washer (32). Slip the lever (28) off the stud (33). Remove the stud (33) after removing the screw (34), lock washer (35), and washer (36). Remove the retaining ring (37) and washer (38), then the lever is free from the stud (39). Remove spring (40).
- (g) Depending on which unit is installed in the platen arm assembly (50), remove either the 16-mm platen assembly (41) or the 35-mm platen assembly (42). Remove the screw (43), washer (44), spring (45), and pin (46) from the housing (67).
- (h) Remove the set screw (47), then slip the lever assembly (48) from the housing. When it is removed, it will release the platen arm assembly (49). To remove the platen bracket assembly (50), remove the two screws (51) and lock washers (52).
- (i) Pull the plug (53) from the end of the take-up spindle assembly (54). To remove the take-up spindle assembly (54), remove the screw (55), lock washer (56), bearing (57) and slip the assembly off the shaft of the spindle assembly (59). Remove the spring washer (58), then remove the spindle assembly (59) by removing the two screws (60).
- (j) Remove the electrical plug (61) by removing the two screws (62). Tag the necessary wires, for future identification and reassembly, before disconnecting them.
- (k) Remove the clamp (63) by removing the screw (64). Remove the clamp (65) by removing the screw (66). There are five clamps mounted in the housing (67) in positions similar to clamps No. 63 and 65. Remove the necessary clamps and screws as the situation demands.
- (4) *Disassembly of camera secondary assemblies (fig. 28).* With the exception of the lens cap (44), the camera secondary assemblies should not be removed and disassembled unless it is necessary to repair or replace a defective component.

- (a) The arm and bearing assembly (1) is not removed from the housing (54). To replace a defective roller assembly (2), remove the two screws (3 and 4); then spring the plates apart enough to remove the roller assembly.
- (b) Remove the roller (5) by removing the screw (6), lock washer (7) and plain washer (8). Remove the spindle and roller base (9) by removing the two screws (10) and lock washers (11).
- (c) Remove the shutter and mirror assembly (12) by removing the four screws (13) and lock washers (14). (Make sure the mirror actuating arm is disconnected before attempting to remove the shutter and mirror assembly (12).) Remove the 16-mm film guide (15) by loosening the captive screw (16).
- (d) Remove the roller (17) by removing the screw (18), lock washer (19), and plain washer (20). Remove the roller (21) by removing the screw (22), lock washer (23), and plain washer (24). Remove the roller (25) by removing the screw (26), lock washer (27), and plain washer (28). It is necessary to remove the rollers to gain access to the screws that hold the roller assembly (29) to the housing.

LEGEND FOR FIGURE 27

1. Screw.	23. Screw.	46. Pin.
2. Lock washer.	24. Lock washer.	47. Set screw.
3. Bezel.	25. Buzzer.	48. Lever assembly.
4. Gasket.	26. Screw.	49. Platen arm assembly.
5. Window.	27. Lock washer.	50. Platen bracket assembly.
6. Mask.	28. Lever.	51. Screw.
7. Gasket.	29. Retaining ring.	52. Retaining ring.
8. Knob.	30. Washer.	53. Plug.
9. Set screw.	31. Retaining ring.	54. Supply spindle assembly.
10. Cord.	32. Washer.	55. Screw.
11. Guard.	33. Stud.	56. Lock washer.
12. Shaft assembly.	34. Screw.	57. Bearing.
13. Screw.	35. Lock washer.	58. Spring washer.
14. Lock washer.	36. Washer.	59. Spindle assembly.
15. Counter assembly.	37. Retaining ring.	60. Screw.
16. Screw.	38. Washer.	61. Connector, receptacle.
17. Lock washer.	39. Stud.	62. Screw.
18. Bezel.	40. Spring.	63. Clamp.
19. Gasket.	41. 16-mm platen assembly.	64. Screw.
20. Window.	42. 35-mm platen assembly.	65. Clamp.
21. Gasket.	43. Screw.	66. Screw.
22. Microswitch.	44. Lock washer.	67. Housing.
	45. Spring.	



TM 2312A-27

Figure 27. Camera primary assemblies.

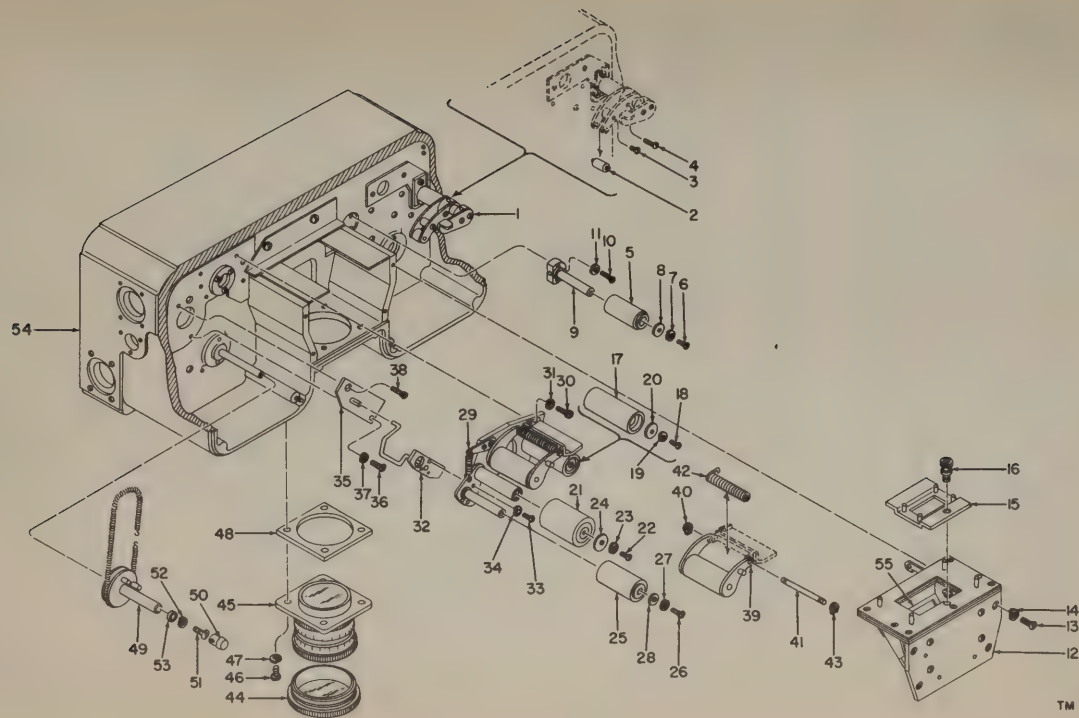
Remove the four screws (30) and lock washers (31). It is necessary to disconnect the switch actuator assembly (32) by removing the three screws (33) and lock washers (34) to remove the roller assembly (29) from the housing. Remove the switch actuator assembly (32) by first removing the light shield (35) that is held in place by the screw (36), lock washer (37), and screw (38). Be careful not to bend the rod attached to the switch actuator assembly (32) when removing it from the housing and from the slot in the light shield.

(e) Remove the roller and plate assembly (39) by removing the retaining ring (40), then sliding the rod (41) from the assembly. Slip off the spring (42). It is not necessary to remove the retaining ring (43).

(f) Screw the lens cap (44) from the lens mount assembly (45). Remove the lens mount assembly (45) by removing the four screws (46) and lock washers (47). Remove

LEGEND FOR FIGURE 28

- | | |
|----------------------------------|--------------------------------|
| 1. Arm and bearing assembly. | 28. Washer. |
| 2. Roller assembly. | 29. Roller assembly. |
| 3. Screw. | 30. Screw. |
| 4. Screw. | 31. Lock washer. |
| 5. Roller. | 32. Switch actuator assembly. |
| 6. Screw. | 33. Screw. |
| 7. Lock washer. | 34. Lock washer. |
| 8. Washer. | 35. Light shield. |
| 9. Spindle and roller base. | 36. Screw. |
| 10. Screw. | 37. Lock washer. |
| 11. Lock washer. | 38. Screw. |
| 12. Shutter and mirror assembly. | 39. Roller and plate assembly. |
| 13. Screw. | 40. Retaining ring. |
| 14. Lock washer. | 41. Shaft. |
| 15. 16-mm film guide. | 42. Spring. |
| 16. Captive screw. | 43. Retaining ring. |
| 17. Roller. | 44. Lens cap. |
| 18. Screw. | 45. Lens mount assembly. |
| 19. Lock washer. | 46. Screw. |
| 20. Washer. | 47. Lock washer. |
| 21. Roller. | 48. Spacer. |
| 22. Screw. | 49. Take-up spindle assembly. |
| 23. Lock washer. | 50. Plug. |
| 24. Washer. | 51. Screw. |
| 25. Roller. | 52. Lock washer. |
| 26. Screw. | 53. Spacer. |
| 27. Lock washer. | 54. Housing. |
| | 55. Shutter. |



TM 2312A-28

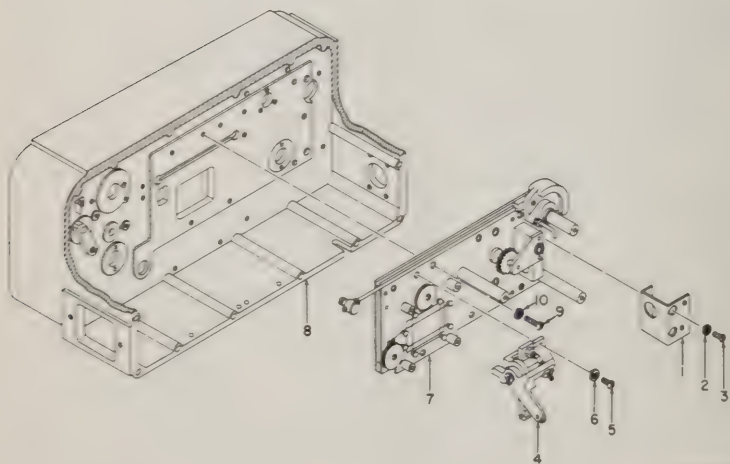
Figure 28. Camera secondary assemblies.

the spacer (48). Do not remove the lens mount assembly from the camera unless it is damaged. Replacing the lens mount assembly (45) and spacer (48) is a precise operation not readily accomplished without special equipment.

- (g) Remove the take-up spindle assembly (49) by removing the plug (50), screw (51), lock washer (52), and spacer (53). (The drive spring was removed in a previous operation and is shown for reference purposes only.)

(5) *Disassembly of camera tertiary assemblies (fig. 29).*

- (a) Remove the bracket (1) by removing the two lock washers (2) and screws (3).
- (b) Remove the cam follower assembly (4) by removing the two screws (5) and lock washers (6).
- (c) Remove the plate assembly (7) from the housing (8) by removing the six screws (9) and lock washers (10) that secure the plate assembly to the housing.



TM 2312A-29

- | | | |
|-----------------|---------------------------|------------------|
| 1. Bracket. | 4. Cam follower assembly. | 8. Housing. |
| 2. Lock washer. | 5. Screw. | 9. Screw. |
| 3. Screw. | 6. Lock washer. | 10. Lock washer. |
| | 7. Plate assembly. | |

Figure 29. Camera tertiary assemblies.

(6) *Disassembly of plate assembly* (fig. 30). The plate assembly should not be disassembled except to repair or replace the mask assemblies. In the event that either the top plate assembly (17) or the bottom plate assembly (18) has to be replaced, it is necessary to replace both plates since the two plates are drilled and pinned during manufacture. Proceed as follows to disassemble the plate assembly:

(a) Remove the retaining ring (1) and washer (2); then slip the footage wheel (3) off the post (4). Remove the screw (5) and the post (4). If the switch actuator (6) is defective, loosen the nut (7) and turn the switch actuator (6) from the footage wheel (3).

(b) Remove the screw (8), lock washer (9), spacer (10), and block (11) from the footage wheel (3). Disconnect the rod (12), loosen the nut (13), and remove the stud (14).

(c) Remove the screw (15) and post (16). Separate the top plate assembly (17) from the bottom plate assembly (18). Carefully remove the mask assembly (19) from the slot in the bottom plate assembly. It is not necessary to disassemble further the mask assembly unless the racks (22 and 24) need to be replaced. Remove the three screws (20), plate (21), gear rack (22), and clip (23); then remove the gear rack (24) from the mask assembly.

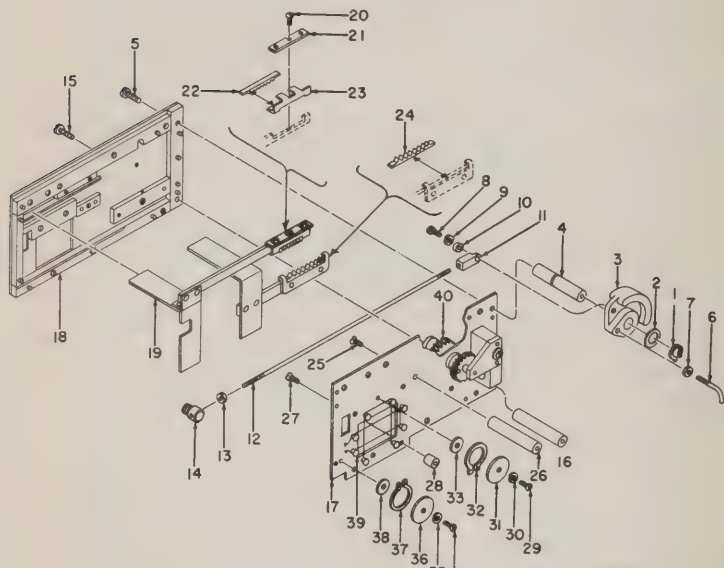
(d) Remove the screw (25) and post (26). Remove the four screws (27) and four posts (28). Do not remove the wire (39) that comprises the stadia conformation unless a wire is broken. See figure 32, stadia conformation, when it is necessary to replace a wire. Remove screw (29), lock washer (30), washer (31), retaining ring (32), and washer (33). Remove screw (34), lock washer (35), washer (36), retaining ring (37), and washer (38). Replace the defective pieces of wires (39) that are attached to the retaining rings (32 and 37).

(7) *Disassembly of feed cam assembly* (fig. 31).

(a) Slip the spur gear (1) off the shaft (2).

(b) Remove the hexagonal nut (3) and plain washer (4) to remove the screw (5). Slip off the spacer (6), pawl assembly (7), spacer (8), and spring (9) as the screw (5) is slipped out of the upper arm assembly (13). Remove washer (10).

- (c) Remove the retaining ring (11) from the ratchet assembly (21); then remove the washer (12), upper arm assembly (13), washer (14), and bushing (15) from the ratchet assembly (21) and off the shaft (2).
- (d) Remove the screw (16) to remove the block (17) from the plate assembly (24). Remove the block (17), two springs (18), clip (19), and wiper (20) from its assembled position against the ratchet assembly (21).

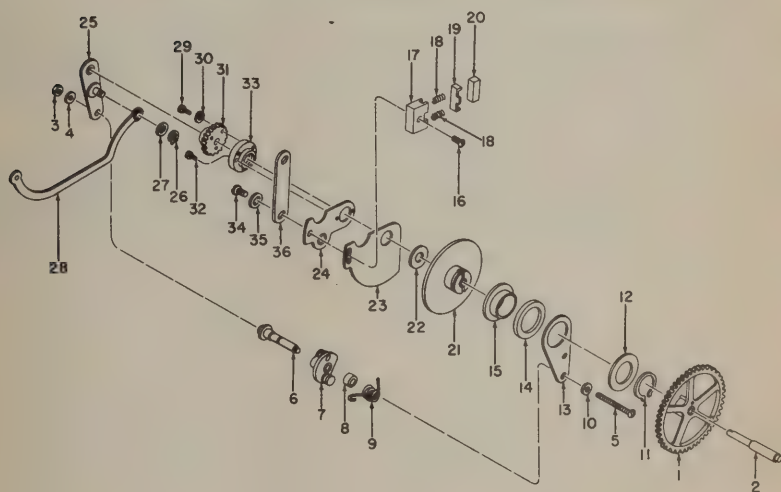


TM 2312A-30

- | | | |
|---------------------|----------------------------|---------------------|
| 1. Retaining ring. | 14. Stud. | 28. Post. |
| 2. Washer. | 15. Screw. | 29. Screw. |
| 3. Footage wheel. | 16. Post. | 30. Lock washer. |
| 4. Post. | 17. Top plate assembly. | 31. Washer. |
| 5. Screw. | 18. Bottom plate assembly. | 32. Retaining ring. |
| 6. Switch actuator. | 19. Mask assembly. | 33. Washer. |
| 7. Nut. | 20. Screw. | 34. Screw. |
| 8. Screw. | 21. Plate. | 35. Lock washer. |
| 9. Lock washer. | 22. Rack, gear. | 36. Washer. |
| 10. Spacer. | 23. Clip. | 37. Retaining ring. |
| 11. Block. | 24. Rack, gear. | 38. Washer. |
| 12. Rod. | 25. Screw. | 39. Wire. |
| 13. Nut. | 26. Post. | 40. Gear assembly. |
| | 27. Screw. | |

Figure 30. Plate assembly.

- (e) From the shaft (2), remove the ratchet assembly (21). washer (22), cam (23) and plate assembly (24).
- (f) Slip the lower arm assembly (25) from the shaft; then remove the retaining ring (26) and washer (27) that secure the lever (28) to the lower arm assembly.
- (g) Remove the three screws (29) and lock washers (30) to unfasten the worm gear (31) from the hub assembly (33). Remove the two screws (32) to separate the hub assembly (33) from the plate assembly (24). Remove the screw (34) and washer (35) to separate the arm (36) from the plate assembly (24).



TM 2312A-31

- | | | |
|---------------------|-------------------------|-------------------------|
| 1. Spur gear. | 13. Upper arm assembly. | 25. Lower arm assembly. |
| 2. Shaft. | 14. Washer. | 26. Retaining ring. |
| 3. Hexagonal nut. | 15. Bushing. | 27. Washer. |
| 4. Plain washer. | 16. Screw. | 28. Lever. |
| 5. Screw. | 17. Block. | 29. Screw. |
| 6. Spacer. | 18. Spring. | 30. Lock washer. |
| 7. Pawl assembly. | 19. Clip. | 31. Worm gear. |
| 8. Spacer. | 20. Wiper. | 32. Screw. |
| 9. Spring. | 21. Ratchet assembly. | 33. Hub assembly. |
| 10. Plain washer. | 22. Washer. | 34. Screw. |
| 11. Retaining ring. | 23. Cam. | 35. Washer. |
| 12. Washer. | 24. Plate assembly. | 36. Arm. |

Figure 31. Feed cam assembly.

b. *Repair of Camera.* The repair of the camera consists of replacing a part that is defective or malfunctioning with a part that is known to be good.

c. *Cleaning of Camera.* Refer to paragraph 49 for general cleaning information.

d. *Lubrication of Camera.* Refer to paragraphs 32, 33, 34, and 35 for lubrication information.

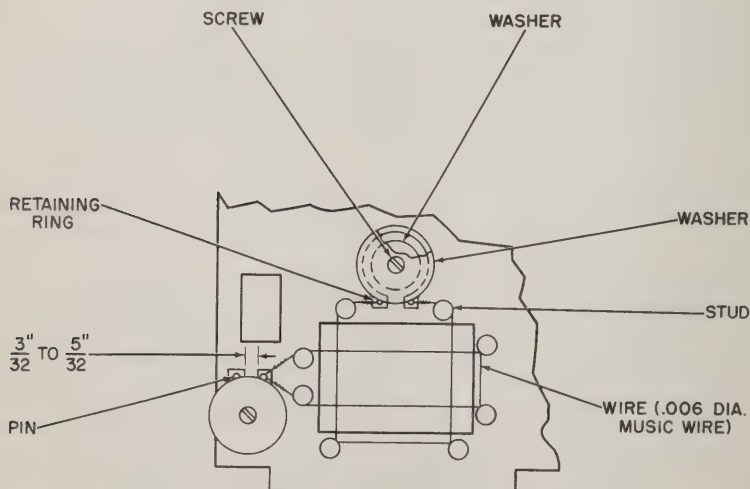
e. *Reassembly of Camera.* Reassembly of camera is accomplished by following in reverse order the instructions for disassembly in subparagraph a above.

57. Control Panel Field Maintenance

a. *Disassembly of Control Panel.* Disassembly of control panel is presented in two stages, primary disassembly and secondary disassembly.

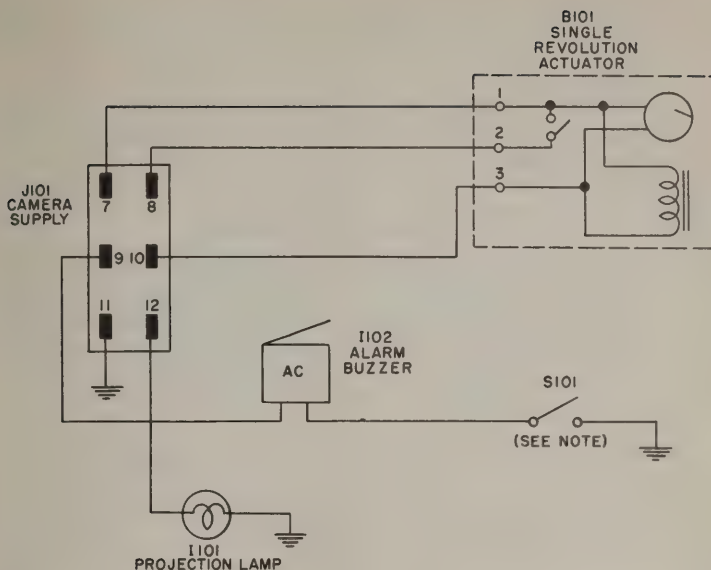
(1) Primary disassembly (fig. 34).

- (a) Remove the nine oval head screws (1). Remove the control panel (2) from the frame (3) after moving the grommet (4) so that the cable and plug assembly (5) is free to move in the opening in the frame.



TM 2312A-32

Figure 32. Stadia conformation.



NOTE: SWITCH S101 IS ACTUATED IF FILM BREAKS OR IF FILM TENSION IS INCORRECT.

TM 2312A-33

Figure 33. Camera schematic.

- (b) Remove the 35-mm film gage (6) from its mounting; then remove the two screws (7) and finger (8). Remove the screw (9) and disassemble the striker plate (11) and post (12) by removing the groove-pin (10).
- (c) Remove the 16-mm film gage (13) from its mounting; then remove the two screws (14) and finger (15). Remove the screw (16) and disassemble the spacer (18), striker plate (19) and post (20) by removing the groove-pin (17).
- (d) Remove the two nuts (21) and screws (22) to remove the handle (23).

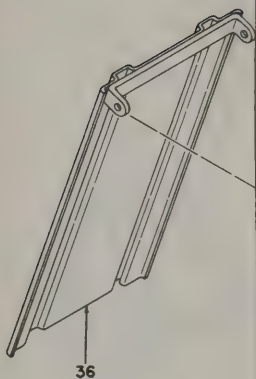
Note. Remove the two screws (24) that hold each of the nameplates (25 through 33) to the control panel, if it is necessary to replace them.

- (e) Remove the two retaining rings (34) from the ends of the rod (35), then remove the rod to free the brace (36) from the frame.

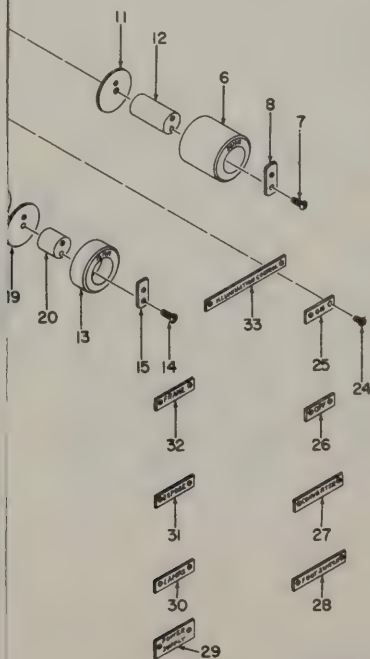
- (f) Remove the six nuts (37) and lock washers (38) to remove the plate (39). Remove the six spacers (40) and screws (41).
- (g) Remove the four nuts (42) and lockwashers (43) to remove the plate (44). Remove the four spacers (45) and screws (46).
- (2) *Secondary disassembly* (fig. 35).
- (a) Remove the two set screws (1), then slip the knob (2) off the shaft of potentiometer (6). Remove the two screws (3), two nuts (4), lock washers (5), and spacers (7). Remove the potentiometer (6) after disconnecting the necessary wires. Tag the wires for identification and reassembly before disconnecting them.
- (b) Remove the resistor (8) from the capacitor (25).
- (c) Remove the two nuts (9), lock washers (10), and screws (12), then remove the switch (11).
- (d) Remove the four nuts (13) and lock washers (14), then remove the voltmeter (15) from the panel (53).

LEGEND FOR FIGURE 34

- | | |
|-----------------------------|------------------------------------|
| 1. Screw, oval head. | 24. Screw. |
| 2. Control panel. | 25. ON nameplate. |
| 3. Frame. | 26. OFF nameplate. |
| 4. Grommet. | 27. CONVERTER nameplate. |
| 5. Cable and plug assembly. | 28. FOOT SWITCH nameplate. |
| 6. 35-mm film gage. | 29. POWER SUPPLY nameplate. |
| 7. Screw. | 30. LAMPS nameplate. |
| 8. Finger. | 31. EXPOSE nameplate. |
| 9. Screw. | 32. FRAME nameplate. |
| 10. Groove-pin. | 33. ILLUMINATION CONTROL nameplate |
| 11. Striker plate. | 34. Retaining ring. |
| 12. Post. | 35. Rod. |
| 13. 16-mm film gage. | 36. Brace. |
| 14. Screw. | 37. Nut. |
| 15. Finger. | 38. Lock washer. |
| 16. Screw. | 39. Plate. |
| 17. Groove-pin. | 40. Spacer. |
| 18. Spacer. | 41. Screw. |
| 19. Striker plate. | 42. Nut. |
| 20. Post. | 43. Lock washer. |
| 21. Nut. | 44. Plate. |
| 22. Screw. | 45. Spacer. |
| 23. Handle. | 46. Screw. |



36



TM 2312A-34

- (f) Remove the six nuts (37) and lock washers (38) to remove the plate (39). Remove the six spacers (40) and screws (41).
- (g) Remove the four nuts (42) and lockwashers (43) to remove the plate (44). Remove the four spacers (45) and screws (46).
- (2) *Secondary disassembly* (fig. 35).
- (a) Remove the two set screws (1), then slip the knob (2) off the shaft of potentiometer (6). Remove the two screws (3), two nuts (4), lock washers (5), and spacers (7). Remove the potentiometer (6) after disconnecting the necessary wires. Tag the wires for identification and reassembly before disconnecting them.
- (b) Remove the resistor (8) from the capacitor (25).
- (c) Remove the two nuts (9), lock washers (10), and screws (12), then remove the switch (11).
- (d) Remove the four nuts (13) and lock washers (14), then remove the voltmeter (15) from the panel (53).

LEGEND FOR FIGURE 34

- | | |
|-----------------------------|------------------------------------|
| 1. Screw, oval head. | 24. Screw. |
| 2. Control panel. | 25. ON nameplate. |
| 3. Frame. | 26. OFF nameplate. |
| 4. Grommet. | 27. CONVERTER nameplate. |
| 5. Cable and plug assembly. | 28. FOOT SWITCH nameplate. |
| 6. 35-mm film gage. | 29. POWER SUPPLY nameplate. |
| 7. Screw. | 30. LAMPS nameplate. |
| 8. Finger. | 31. EXPOSE nameplate. |
| 9. Screw. | 32. FRAME nameplate. |
| 10. Groove-pin. | 33. ILLUMINATION CONTROL nameplate |
| 11. Striker plate. | 34. Retaining ring. |
| 12. Post. | 35. Rod. |
| 13. 16-mm film gage. | 36. Brace. |
| 14. Screw. | 37. Nut. |
| 15. Finger. | 38. Lock washer. |
| 16. Screw. | 39. Plate. |
| 17. Groove-pin. | 40. Spacer. |
| 18. Spacer. | 41. Screw. |
| 19. Striker plate. | 42. Nut. |
| 20. Post. | 43. Lock washer. |
| 21. Nut. | 44. Plate. |
| 22. Screw. | 45. Spacer. |
| 23. Handle. | 46. Screw. |

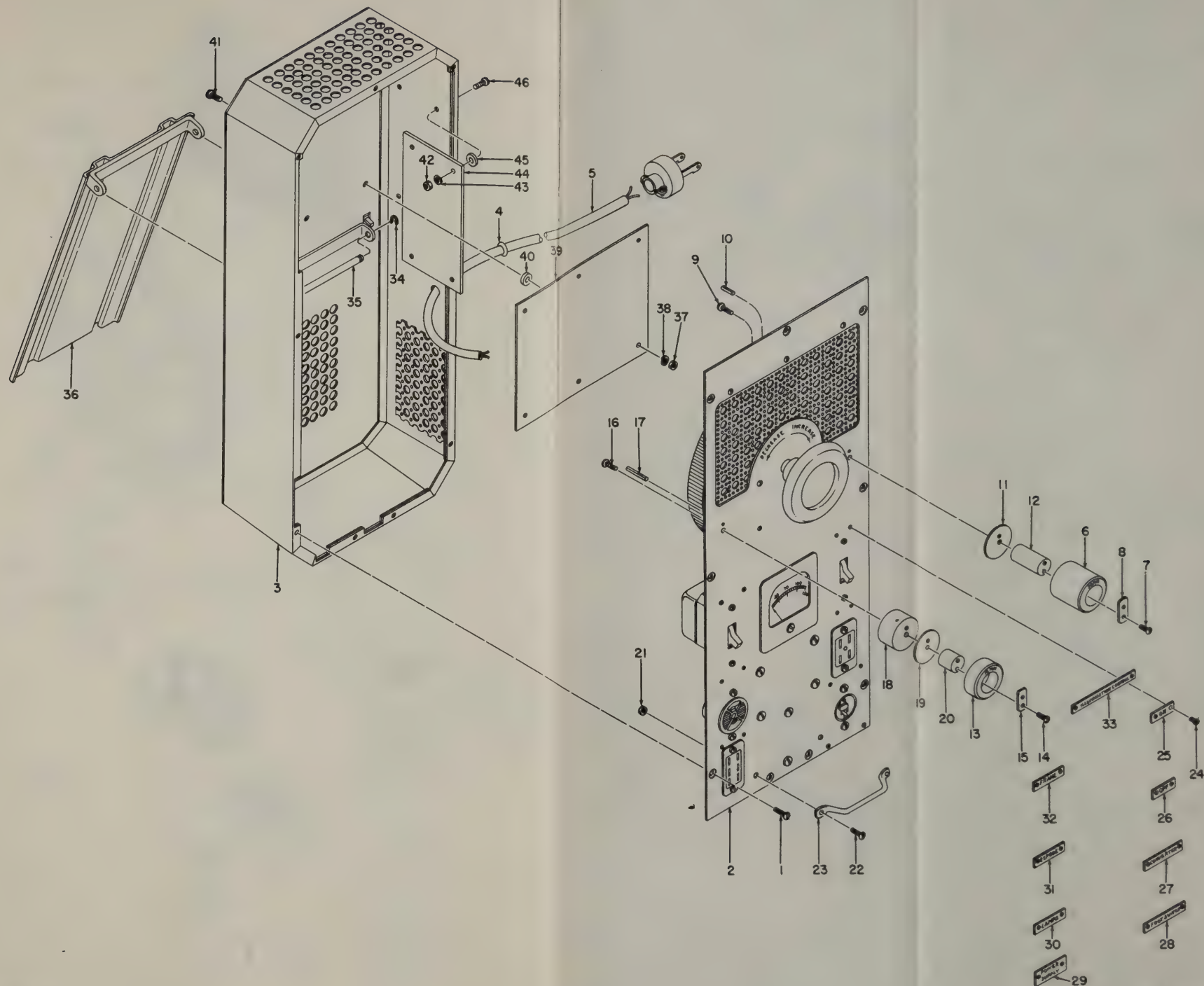


Figure 34. Control panel assembly, front view.

TM 2312A-34

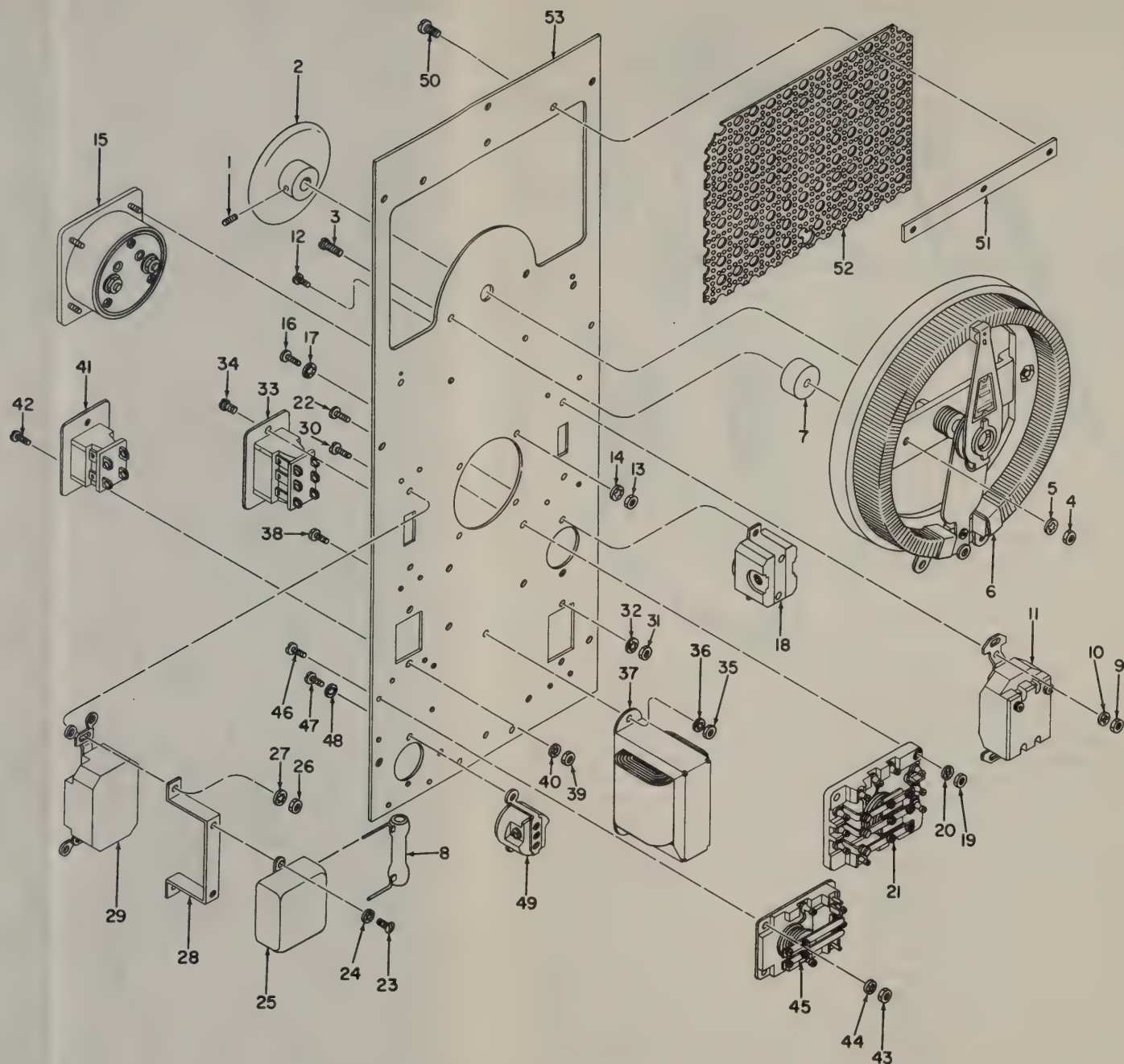
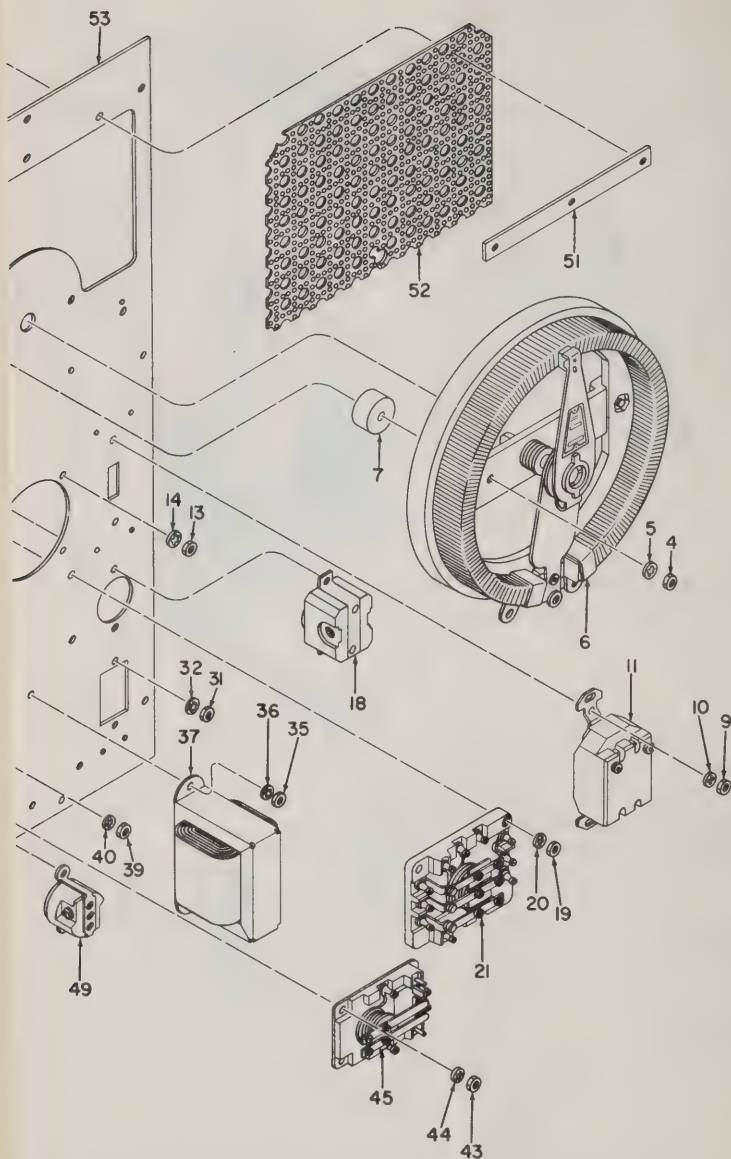


Figure 35. Control panel assembly, rear view.

TM 2312A-35



TM 2312A-35

Figure 35. Control panel assembly, rear view.

- (e) Remove the two screws (16) and lock washers (17), then remove the receptacle (18) after disconnecting the necessary wires.
- (f) Remove the four nuts (19), lock washers (20), and screws (22), then remove the relay (21) after disconnecting the necessary wires.
- (g) Remove the two screws (23) and lock washers (24), then lift the capacitor (25) from the bracket (28) after disconnecting the necessary wires. Remove the two nuts (26), lock washers (27), and screws (30). Remove the bracket (28) and switch (29) from the panel (53) after disconnecting the necessary wires.
- (h) Remove the two nuts (31), lock washers (32), and screws (34), then remove the socket (33) from the panel after disconnecting the necessary wires.
- (i) Remove the two nuts (35), lock washers (36), and screws (38), then remove the transformer (37) after disconnecting the necessary wires.
- (j) Remove the two nuts (39), lock washers (40), and screws (42), then remove the socket (41) after disconnecting the necessary wires.
- (k) Remove the four nuts (43), lock washers (44), and screws (46), then remove the relay (45) from the panel after disconnecting the necessary wires.

LEGEND FOR FIGURE 35

1. Set screw.	19. Nut.	36. Lock washer.
2. Knob.	20. Lock washer.	37. Transformer.
3. Screw.	21. Relay.	38. Screw.
4. Nut.	22. Screw.	39. Nut.
5. Lock washer.	23. Screw.	40. Lock washer.
6. Potentiometer.	24. Lock washer.	41. Connector, receptacle.
7. Spacer.	25. Capacitor.	42. Screw.
8. Resistor.	26. Nut.	43. Nut.
9. Nut.	27. Lock washer.	44. Lock washer.
10. Lock washer.	28. Bracket.	45. Relay.
11. Switch.	29. Switch.	46. Screw.
12. Screw.	30. Screw.	47. Screw.
13. Nut.	31. Nut.	48. Lock washer.
14. Lock washer.	32. Lock washer.	49. Receptacle.
15. Voltmeter.	33. Connector, receptacle.	50. Screw.
16. Screw.	34. Screw.	51. Plate.
17. Lock washer.	35. Nut.	52. Grille.
18. Receptacle.		53. Panel.

(l) Remove the two screws (47) and lock washers (48), then remove the receptacle (49) from the control panel after disconnecting the necessary wires.

(m) Remove the three screws (50) and remove the plate (51) and grille (52) from the panel (53) .

b. Repair of Control Panel. The repair of the control panel consists of replacing a defective or malfunctioning part with a part that is known to be good.

c. Cleaning of Control Panel. Refer to paragraph 49 for general cleaning information.

d. Lubrication of Control Panel. No lubrication is necessary.

e. Reassembly of Control Panel. Refer to paragraph 57 and reverse procedure for disassembly.

58. Light Meter Field Maintenance

a. Disassembly of Meter Assembly (fig. 38). Remove the eight machine screws (1) and bezel (2), two neoprene gaskets (3), and window (4) from housing (18). Remove the 10 machine screws (5); then remove the bezel (6), two neoprene gaskets (7), glass plate (8), felt gasket (9), plate (10), brass spring (11), spacer (12), felt gasket (13), filter (14), and plate (15). Remove the light meter (16) and felt packing (17) from the housing (18).

Caution: Do not expose the light meter (16) to strong light. If possible, remove the light meter in subdued light conditions, or cover the meter opening with an opaque material to prevent damage to the meter.

b. Repair of Meter Assembly. The repair of the meter assembly consists of replacing the meter, when it becomes defective or is malfunctioning, with a meter known to be good.

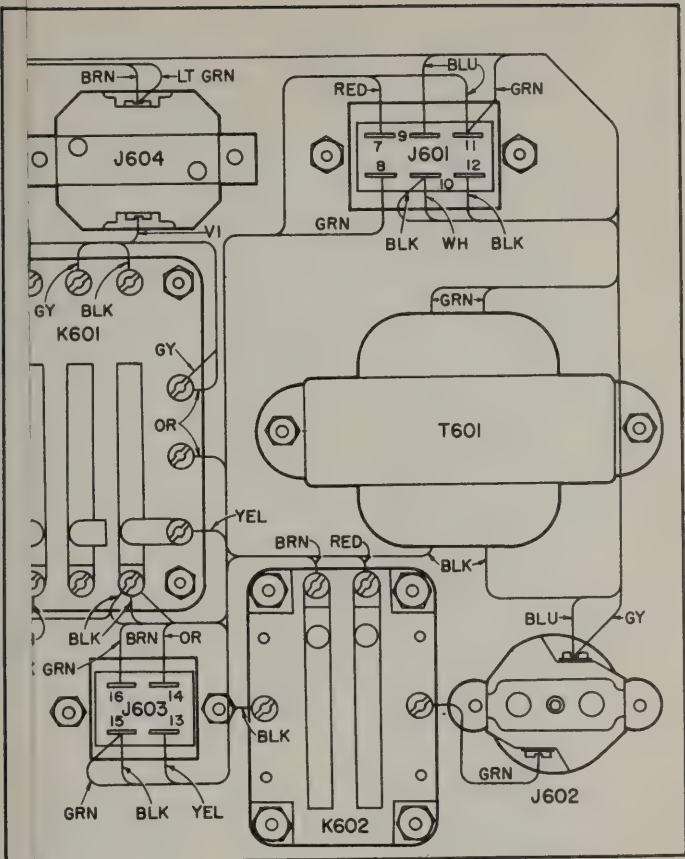
c. Cleaning of Meter Assembly. It is only necessary to keep the lenses clean by using the lens cleaner and lens tissue.

d. Lubrication of Meter Assembly. No lubrication is necessary.

e. Reassembly of Meter Assembly. Reassembly of the control panel is accomplished by following the instructions for disassembly in reverse order.

59. Camera Stand Field Maintenance

Field maintenance procedure for the camera stand consists of replacing a defective part with a part that is known to be good. A clean cloth is used to keep the stainless-steel stand clean. Refer to paragraph 34



(l) Remove the two screws (47) and lock washers (48), then remove the receptacle (49) from the control panel after disconnecting the necessary wires.

(m) Remove the three screws (50) and remove the plate (51) and grille (52) from the panel (53) .

b. Repair of Control Panel. The repair of the control panel consists of replacing a defective or malfunctioning part with a part that is known to be good.

c. Cleaning of Control Panel. Refer to paragraph 49 for general cleaning information.

d. Lubrication of Control Panel. No lubrication is necessary.

e. Reassembly of Control Panel. Refer to paragraph 57 and reverse procedure for disassembly.

58. Light Meter Field Maintenance

a. Disassembly of Meter Assembly (fig. 38). Remove the eight machine screws (1) and bezel (2), two neoprene gaskets (3), and window (4) from housing (18). Remove the 10 machine screws (5); then remove the bezel (6), two neoprene gaskets (7), glass plate (8), felt gasket (9), plate (10), brass spring (11), spacer (12), felt gasket (13), filter (14), and plate (15). Remove the light meter (16) and felt packing (17) from the housing (18).

Caution: Do not expose the light meter (16) to strong light. If possible, remove the light meter in subdued light conditions, or cover the meter opening with an opaque material to prevent damage to the meter.

b. Repair of Meter Assembly. The repair of the meter assembly consists of replacing the meter, when it becomes defective or is malfunctioning, with a meter known to be good.

c. Cleaning of Meter Assembly. It is only necessary to keep the lenses clean by using the lens cleaner and lens tissue.

d. Lubrication of Meter Assembly. No lubrication is necessary.

e. Reassembly of Meter Assembly. Reassembly of the control panel is accomplished by following the instructions for disassembly in reverse order.

59. Camera Stand Field Maintenance

Field maintenance procedure for the camera stand consists of replacing a defective part with a part that is known to be good. A clean cloth is used to keep the stainless-steel stand clean. Refer to paragraph 34

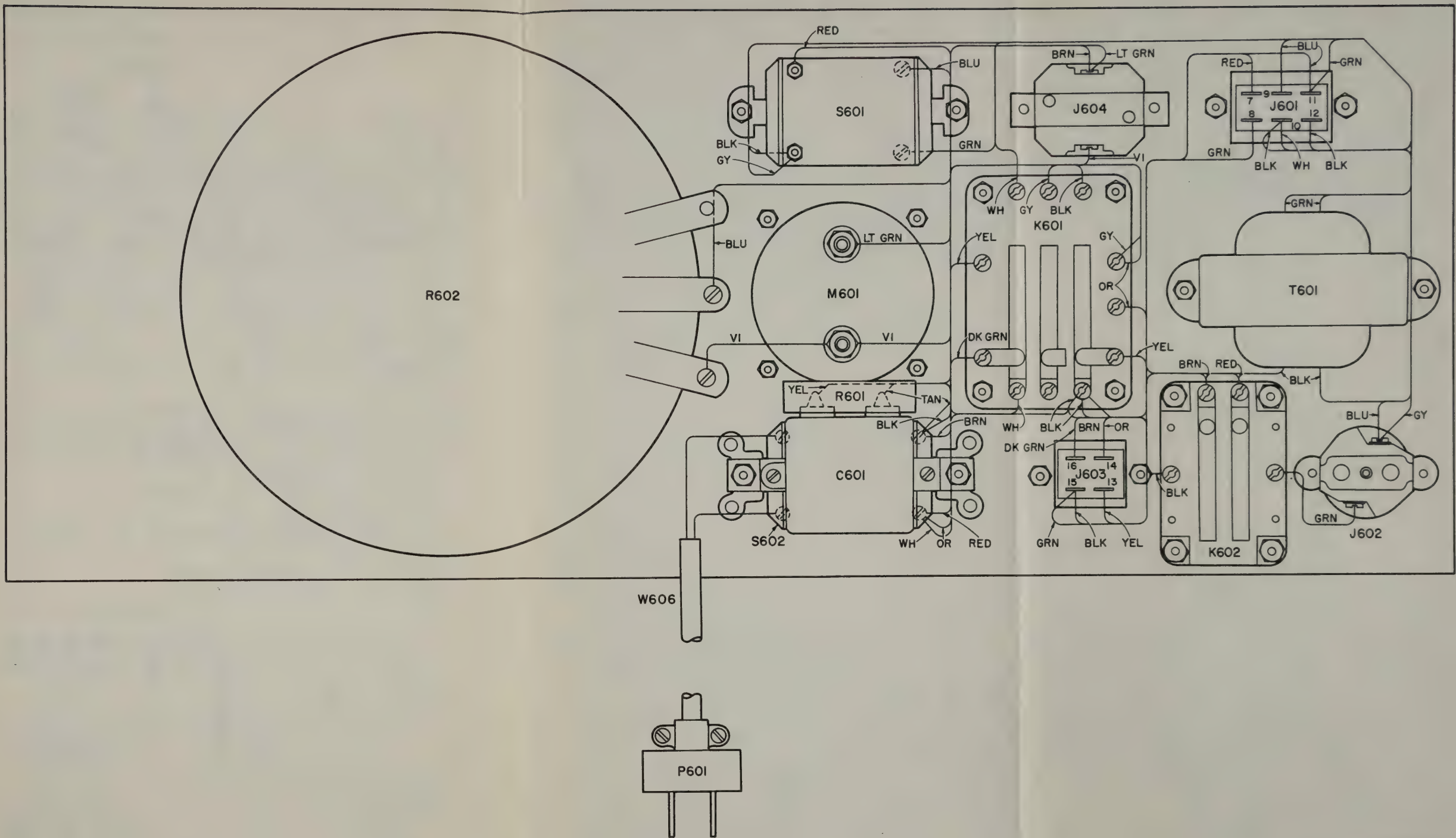


Figure 36. Control panel wiring diagram.

for lubrication information and paragraph 14 for assembly instructions. Disassembly of the camera stand is accomplished by following in reverse order the instructions for assembly in paragraph 14.

60. Refinishing

Check all surfaces for appearance and condition of finish. Refinishing of components is seldom necessary except when the equipment is reconditioned. When the finish has been completely removed or worn thin, retouch (with Specification 72-53 olive-drab or dull black) the affected surfaces, after sanding and cleaning them. To remove the old finish, use paint and varnish remover on painted areas after the equipment has been stripped. Wash off paint remover with turpentine and then with solvent (SD) before applying new finish. Apply new finish with a soft-bristle paint brush or spray after masking off all those parts which are not to be coated. When the coating of protective varnish has been broken, the affected parts must be moistureproofed and fungi-proofed again as described in TB SIG 13. Be careful during moisture-proofing and fungiproofing to prevent lacquer from coating the surfaces of electrical contacts and rendering the equipment inoperative.

Caution: Do not use steel wool in refinishing the equipment since minute particles frequently enter the equipment and cause malfunctions or complete inoperation. Never use lye solution (NaOH) or any harsh cleaning agent for cleaning aluminum or wooden parts.

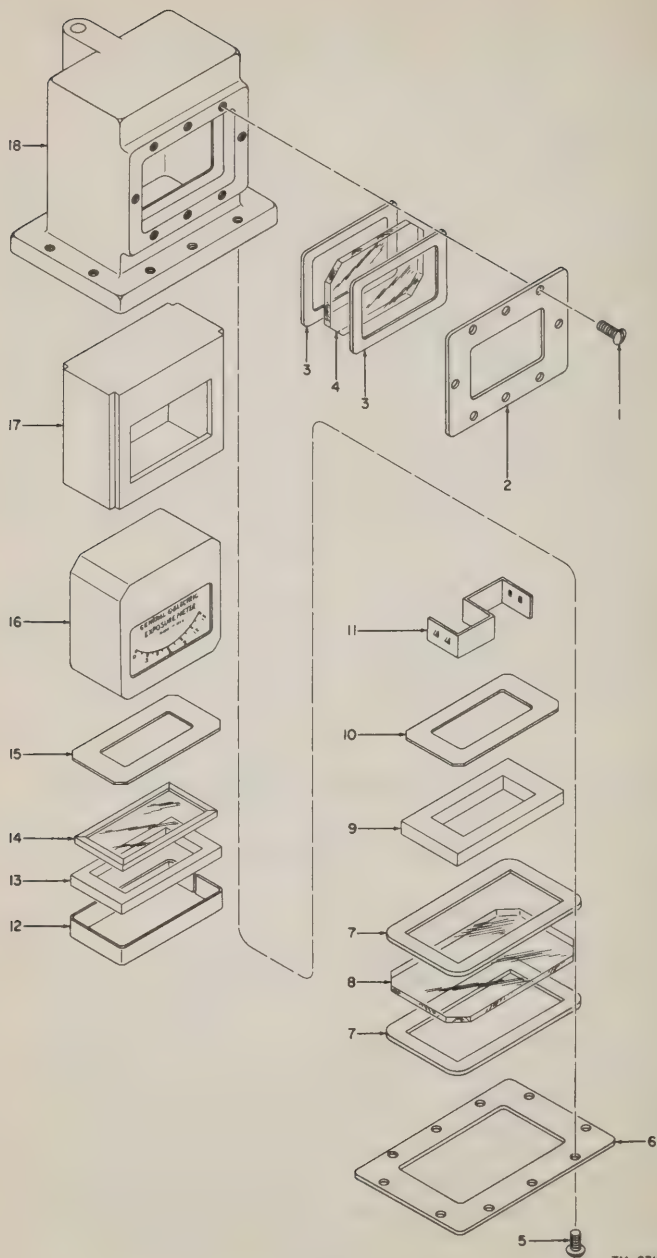
Section IV. ALINEMENT PROCEDURES AND

FINAL TESTING

61. Final Adjustments

Instructions for adjustments made after the equipment is reassembled are furnished in the following subparagraphs.

a. Adjustment of Mask Assembly (19, fig. 30). Assemble the racks (22 and 24) to the mask assembly (19). Insert the mask assembly (19) into the slot in the bottom plate assembly (18). Center the masks in the aperture opening in the plate and arrange them in a wide-open position. Mesh the racks (22 and 24) with the gear assembly (40). The masks should move freely but with a minimum of play. Maximum mask travel should be the same as the maximum aperture opening. Final adjustment of the masks is made by repositioning the racks (22 and 24) to effect full travel and proper centering of the masks.



TM 2312A-38

Figure 38. Meter assembly.

b. Adjustment of Feed Cam Assembly (21, fig. 26) and Shaft Assembly (12, fig. 27). When installing the shaft assembly, make sure the worm (32, fig. 26) on the end of the shaft assembly meshes with the worm gear (31). When installing the feed cam assembly (21) make sure the worm gear (33) meshes properly with the worm (32) on the shaft assembly (12, fig. 27).

c. Shutter Adjustment. The shutter assembly is adjusted to effect a fully opened and completely closed shutter. The adjustment is made by loosening the nut (34, fig. 26) and turning the screw (35) on the cam follower assembly (4, fig. 29). The fully open position is realized when the cam follower on the lever arm assembly (37, fig. 26) is at the highest point on the cam (36) on the motor assembly (8). Set the adjustment to bring about the largest interval between the time the platen arm assembly (49, fig. 27) moves downward to hold the film strip secure and the time the shutter opens to expose the film.

d. Adjustment of UNEXPOSED FOOTAGE indicator (fig. 3). Place a full 100-foot roll of film in camera. The UNEXPOSED FOOTAGE indicator should indicate 100 feet, but if it does not, loosen the nut (13, fig. 30) and turn the rod (12) to make the necessary correction, then retighten the nut (13). Recheck the UNEXPOSED FOOTAGE indicator for proper indication.

e. Microswitch Adjustment. Adjust the actuating levers from the roller assembly (29, fig. 28) and the arm and bearing assembly (1), so that the buzzer sounds to signal that the film is not feeding properly, the supply is exhausted, or the film is broken. The microswitch (22, fig. 27) is secured with two screws (23) and washers (24).

f. Film Transport Spacing Adjustment. Spacing between film frames should be a maximum of 1/32 inch. Set aperture masks to the fully open position. Remove the worm shaft assembly (12, fig. 27). On the motor assembly (8, fig. 26), set the cam (36) to the maximum feed position. Now adjust the cam until pawl just engages. Insert the worm shaft assembly (12, fig. 27). Transport 10 frames of film through the camera; then measure the transported length of film. For final adjustment of spacing, loosen the #4-40NC machine screw in block and shift cam; then retighten the screw. Recheck film frame spacing for proper spacing.

LEGEND FOR FIGURE 38

- | | | |
|---------------------|---------------------|-------------------|
| 1. Machine screw. | 7. Neoprene gasket. | 13. Felt gasket. |
| 2. Bezel. | 8. Glass plate. | 14. Filter. |
| 3. Neoprene gasket. | 9. Felt gasket. | 15. Plate. |
| 4. Window. | 10. Plate. | 16. Light meter. |
| 5. Machine screw. | 11. Brass spring. | 17. Felt packing. |
| 6. Bezel. | 12. Spacer. | 18. Housing. |

g. Adjustment of Counter (15, fig. 27). The counter is used to count each exposure on the back stroke of the linkage. The operator must be able to reset the counter at the end of each cycle. Adjust the counter by changing the position of the feed cam on the feed drive linkage assembly (38, fig. 26).

h. Adjustment of Lamp (12, fig. 26). The lamp should completely illuminate the projected area at the largest opening of the aperture up to $f/8$. At settings less than $f/8$, the pattern of projected light should exhibit a bright circle at the center surrounded by a dark ring, and with bright areas at the corners. Adjust the light to conform to this light pattern by moving the lamp in or out, and by moving the lamp mounting plate from side to side and up or down.

i. Adjustment of Mirror Assembly (12, fig. 28). Project a light pattern on the easel (fig. 22), and mask off the projected field area. Remove the platen (41 or 42, fig. 27) from the platen arm assembly (49). Put a piece of tracing paper or ground glass against the film plane. With a beam of light, trace the outline of the film plane opening. See if the outline indicated by the beam of light corresponds with the projected field area outlined on the easel. Adjustments can be made by bending the stop bracket of the shutter and mirror assembly (12, fig. 28).

62. Testing

a. The tests given below are used as guides in determining the quality of a repaired component. These tests may be performed by maintenance personnel with the necessary skills and without test equipment.

b. After the equipment has been repaired, set it up and operate it. Check the quality of the finished negatives. Be sure to try different films, several different aperture openings and reduction factor settings. Check the film for proper framing, correct film advance, and all phases of camera position. Refer to paragraph 61 for camera equipment adjustments.

CHAPTER 6

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

63. Disassembly for Storage

When Camera PH-545A/PF equipment is to be stored, repack it in the camera carrying case (fig. 12) and the camera stand carrying case (fig. 11) as illustrated, and as explained in paragraphs 8 and 9. Disassembly instructions are the reverse of the assembly instructions.

64. Repacking for Shipment or Limited Storage

Reverse the unpacking instructions to pack equipment for either shipment or limited storage. If the equipment is to be transported only from one location to another, just repack the components in the camera carrying case and the camera stand carrying case.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

65. General

The demolition procedures outlined in paragraph 66 will be used to prevent the enemy from using or salvaging the equipment. Demolition of the equipment will be accomplished only upon order of the commander.

66. Methods of Destruction

a. Smash. Smash all lenses, glass, internal parts; use sledges, axes, handaxes, pickaxes, hammers, crowbars, or other heavy tools.

b. Cut. Cut film, fabric, leatherette; use axes, handaxes, or machetes.

c. *Burn*. Burn film, fabric, leatherette, instruction books; use gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. *Dispose*. Bury or scatter the destroyed parts in slit trenches, fox holes or other holes, or throw them into stream.

e. *Destroy*. Destroy everything.

INDEX

	<i>Paragraph</i>	<i>Page</i>
A		
Accessories	6	11
Alinement procedures	61	101
Arctic, operation in	23, 36b	46, 56
Auxiliary equipment	43	65
C		
Camera body:		
Description	3, 5	3, 6
Field maintenance	56	77
Camera stand:		
Assembly	14	19
Description	6	11
Field maintenace	59	98
Lubrication	34b	54
Carrying cases	8	14
Cleaning	19, 51	29, 72
Components	4	4
Control panel assembly:		
Description	7	13
Field maintenance	57	92
Installation	16	24
Instruments and controls	18a	27
Conversion kit	5e	11
Cover assembly	5c	9
D		
Demolition of materiel	65, 66	105
Description, general	3	3
Desert, operation in	24, 36c	46, 56
Disassembly:		
Camera	56a	77
Control panel	57	92
Meter assembly	58	98
E		
Electrical connections	16	24

	Paragraph	Page
F		
Field maintenance:		
Camera	56	77
Camera stand	59	98
Control panel	57	92
Light meter	58	98
Film:		
Loading and threading	20c	35
Selection	20a	31
Unloading	21a 21b	44
Film compartment	5b	7
Forms and records	1 31	1 52
I		
Inclosure doors	5b	7
Inspection	49	71
Installation of camera:		
Horizontal	15b	14
Vertical	15a	13
Instruments and controls	18	27
L		
Lens assembly	5d	10
Light meter	18c	28
Field maintenance	58	98
Loading equipment	19	19
Lubrication	30-35 36d	54 57
M		
Maintenance (See Preventive maintenance Field maintenance)		
Mechanism compartment	5c	9
O		
Operation	44-48	65
Electrical system theory	46	67
Horizontal	11b	42
Mechanical theory	47	69
Optical system theory	45	65
Under unusual conditions	23	46
Vertical	11a	37
Operational cycle	48	70

	<i>Paragraph</i>	<i>Page</i>
P		
Packaging	11, 65	15, 105
Painting	37	57
Preliminary procedure	20	31
Preloading instructions	19	29
Preventive maintenance:		
Checklist	30	49
Definition	28	49
Details	29	49
Forms	31	52
R		
Reconditioned equipment	17	26
Reduction factor	20b, 45b	33, 66
Refinishing	60	101
Repair:		
Camera	56b	92
Control panel	57b	98
General	55	77
Meter assembly	58b	98
Rustproofing	37	57
S		
Scope	1	1
Shipment, packing for	11, 65	15, 105
Shutdown:		
Extended	22c	45
Limited	22d	45
Spare parts	9	14
Storage	64, 65	105
T		
Technical characteristics	10	14
Testing	62, 63	104, 105
Tools and materials needed	27	48
Tropics, operation in	25, 36a	47, 56
Trouble shooting:	38, 52, 53	57, 72
Chart	54	73
Checklist	41, 42	58, 60
Electrical	53a, 54a	72, 74
Mechanical	53c, 54b	73, 75

	<i>Paragraph</i>	<i>Page</i>
Optical	53b, 54b	73, 75
System sectionalization	40	58
Visual inspection	39	58
U		
Unpacking new equipment	12	18
Unusual weather conditions	23-26, 35, 36	46, 56
Used equipment	17	26
W		
Weatherproofing	36	56

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